

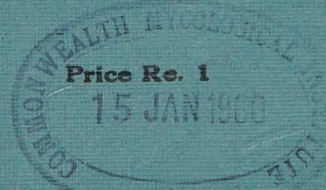
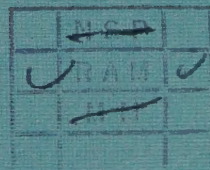
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RESEARCH DEPARTMENT

BULLETIN No. 11



ELEVENTH ANNUAL REPORT
OF
THE RESEARCH DEPARTMENT
OF THE
COFFEE BOARD
1957—1958

PUBLISHED BY THE DIRECTOR OF RESEARCH
COFFEE BOARD, BALEHONNUR P.O.
SOUTH INDIA



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COFFEE BOARD

RESEARCH DEPARTMENT

THE ELEVENTH ANNUAL REPORT

1957-58

PART I

ADMINISTRATION

The Report covers the period from 1-8-1957 to 31-7-1958.

2. I was in charge of the Research Department throughout the year under report. The following officers continued to hold charge of the respective posts during the year:—

Dr. N. G. Chokkanna	..	..	Chemist
Sri. R. L. Narasimhaswamy	..	..	Botanist
„ K. V. George	..	..	Mycologist
„ B. S. Kuppuswami	..	..	Agronomist
Dr. P. Somasekhar	..	..	Entomologist (from 17-10-1957)
Sri. Lazar Soans	..	..	Secretary to Director of Research
„ P. K. Mathew	..	..	Asst. Chemist (till 15-6-1958)
„ S. Vishveshwara	..	..	Asst. Botanist
„ W. Raghavendra Rao	..	..	Senior Liaison Officer
„ T. V. Pattabhiraman	..	..	do.
„ G. I. D'Souza	..	..	do.
„ B. K. Chandrappa	..	..	do.
„ S. J. Mathias	..	..	Junior Liaison Officer
„ K. T. Bhagat	..	..	do.
„ H. S. Puttuswamy	..	..	do.
„ R. Vijaendraswamy	..	..	do.
„ K. C. Ananth	..	..	do.
„ L. V. Vaidyanathan	..	..	do.
„ H. T. Ranga Setty	..	..	do.
„ H. Hanumantha Rao	..	..	do.
„ C. K. Ponnappa	..	..	do. (under training from 4-2-1958)
„ C. Ramakrishnan Nambiar	..	..	Superintendent.

3. Dr. P. Somasekhar was appointed as Entomologist in the Research Department of the Coffee Board. He joined duty on 17th October, 1957.

4. Sriyuths Lazar Soans and C. Ramakrishnan Nambiar continued as Secretary to the Director of Research and Superintendent, Coffee Research Sub-Station, Chethalli, respectively during the year under report. Sri. P. K. Mathew, Asst. Chemist, was relieved on the forenoon of 16th June, 1958, consequent on his appointment as Asst. Soil Chemist in charge of the Soil Testing Centre at Balehonnur under the expanded Soil Testing Service Scheme of the Government of India.

Extension Service

5. I was in charge of direction and supervision of the Liaison Service and continued to hold direct supervisory charge of the Shevaroy's Liaison District.

6. The jurisdiction of the Senior Liaison Officers were realigned during April, 1958, with a view to increase the usefulness of the advisory services and streamline the activities of the Liaison Section. Two new Liaison Districts comprising the Nilgiris District of the Madras State and the Koppa-Sangameswarpet-Magundi Section of the Chikmagalur District were formed towards the close of the year thus bringing the total number of Liaison Districts to ten.

7. Sri. T. V. Pattabhiraman, Senior Liaison Officer, Coimbatore, was in direct charge of the coffee areas on the Anamallais, Nelliampathies and other coffee areas of the former Travancore-Cochin State. He was also in direct charge of the coffee areas on the Nilgiris till the middle of June 1958, when this was constituted into a new district and came under his supervisory charge. He held supervisory charge of the Pulneys and the North Kerala (Wynaad) Liaison District. The North Kerala area was transferred to the supervisory charge of Senior Liaison Officer, South Mysore, with effect from April 1958.

8. Sri. G. I. D'Souza, Senior Liaison Officer, Chikmagalur, was transferred to Somwarpet in charge of the new South Mysore Liaison Division comprising the Liaison Districts of North Coorg, South Coorg and North Kerala (Wynaad). He joined duty at Somwarpet on 17-4-1958. The Senior Liaison Officer was in direct additional charge of the North Coorg Liaison District.

9. Sri. B. K. Chandrappa, Senior Liaison Officer, Saklespur, was placed in charge of the realigned North Mysore Liaison Division comprising the Liaison Districts of Chikmagalur, Mudigere and Saklespur, with effect from 17-4-1958. Sri. H. T. Ranga Setty, Junior Liaison Officer, Saklespur, was relieved on the forenoon of 26th July, 1958, consequent on his transfer as Special Officer, Proprietary Products Testing Scheme. Sri. B. K. Chandrappa held direct additional charge of the above post with effect from that date.

10. Sri. W. Raghavendra Rao, Senior Liaison Officer (Development), continued to work under the Coffee Development Plan with headquarters at Balehonnur.

In the reorganised set up, the newly created Koppa-Sangameswarpet-Magundi Liaison District was placed under his direct additional charge from the middle of April, 1958.

11. Consequent on the reorganisation of the liaison services and the realignment of the Liaison Districts, the following transfers were effected. Sri. K. T. Bhagat, Junior Liaison Officer, Somwarpet, was posted to Mudigere, relieving Sri. H. S. Puttuswami, transferred as Junior Liaison Officer, Chikmagalur. Sri. S. J. Mathias was transferred from Chikmagalur and placed in charge of Pulneys Liaison District. Sri. K. C. Ananth was posted as Junior Liaison Officer to the newly formed District of Nilgiris with headquarters temporarily at Coimbatore pending its final location at Coonoor.

Sri. C. K. Ponnappa who was appointed as Junior Liaison Officer reported for duty on 4-2-1958, and was under training at the Coffee Research Station, Balehonnur, and in a private estate till the end of the year.

12. The officers and staff on duty on 31-7-1958 and the sanctioned strength are as below:—

Category		Sanctioned strength	No. working
Class I	.. ..	1	1
Class II—			
Heads of Sections	.. ..	5	5
Assistant Research Officers	.. ..	4	1
Senior Liaison Officers	.. ..	4	4
Junior Liaison Officers	.. ..	12	9*
Farm and Administration	.. ..	3	2
Class III—			
Technical	.. ..	102	59
Ministerial	.. ..	38	37
Class IV—			
Attenders, drivers, etc.	.. ..	42	39
		211	157

* Including one under training.

The details of the various posts and categories are given in Appendix I. Proposals are under active consideration for the filling up of field staff attached to the Liaison Officers.

Consequent on the setting up of special projects and the expansion of the liaison and advisory services, a review of the staff requirements of the Research Department under all categories of service was taken up. Based on the recommendations of the Research Committee, a special *Ad Hoc* Body was constituted to finalise the general set up and the future structure of the Department. This

Body has submitted its recommendations for consideration by the Research Committee.

13. During the year the following posts were filled either after advertisement or by transfer from other departments of the Board:—

Entomologist	..	..	1
Junior Liaison Officer	..	..	1
Research Assistants	..	..	5 (one since resigned)
Class IV staff	..	..	1

One Research Assistant in Chemistry who reported for duty on 26th June, 1958, resigned his post and left the Department on 15th July, 1958. The Junior Liaison Officer and two Research Assistants were given training in the several technological sections at Balehonnur for periods ranging from one to three months. The Statistical Assistant was given training in agricultural statistical methods with particular reference to coffee for a period of 50 days under the Statistical Officer, Coffee Board, and the State Statistician, Government of Mysore, Bangalore.

Leave

14. The following officers were on leave during the year for the periods noted against each:—

Sri. R. L. Narasimhaswamy, Botanist	..	..	34 days
„ K. V. George, Mycologist	..	..	66 „
„ B. S. Kuppaswami, Agronomist	..	..	22 „
„ S. Vishveshwara, Asst. Botanist	..	..	15 „
„ P. K. Mathew, Asst. Chemist	..	..	36 „
„ H. S. Puttuswamy, Junior Liaison Officer	..	..	25 „
„ S. J. Mathias	do.	..	45 „
„ H. Hanumantha Rao	do.	..	75 „
„ G. I. D'Souza, Senior Liaison Officer	..	..	10 „
„ T. V. Pattabhiraman	do.	..	37 „
„ W. Raghavendra Rao	do.	..	25 „
„ K. T. Bhagat, Junior Liaison Officer	..	..	30 „
„ R. Vijaendraswamy, Junior Liaison Officer	..	..	28 „
„ Lazar Soans, Secretary to Director of Research	..	..	15 „

The several technical and ministerial staff were on earned leave for varying periods during the year.

Tours

15. I was on tour for 180 days in the year to attend the meetings of the Board and its Committees, and to visit areas in Mysore, Coorg, Wynaad, Shevaroy's,

Nilgiris and Pulneys. The visits to the liaison zones were mainly for advisory work in problem areas, inspection of the layout and working of the demonstration and exploratory trial plots, selection of sites for the Field Regional Stations and in connection with the working of the schemes under the Development Plan.* I visited 150 big and an equal number of small estates. The Sub-Station at Chethalli was visited eight times covering a stay of twenty days during the year for inspection and conduct of research. I attended the Indian Standards Institution Convention held in Madras during the last week of December, 1957, and the Soil Testing Officers' Conference at Bangalore in May, 1958.

16. The Heads of the Research Sections were on tours for the periods noted below against each. Tours in the several liaison zones were undertaken in connection with advisory work, visits to Sub-Station, Chethalli; inspection of seed blocks of Station Selections, collection of promising material for breeding work and inspection of experimental plots for collection of data. The Chemist, in addition, participated in the several important exhibitions in the south.

Dr. N. G. Chokkanna, Chemist	..	87 days
Sri. R. L. Narasimhaswamy, Botanist	..	43 ,,
,, K. V. George, Mycologist	..	28 ,,
,, B. S. Kuppaswami, Agronomist	..	50 ,,
Dr. P. Somasekhar, Entomologist	..	13 ,,

17. The Asst. Research Officers, the Research Assistants and the field staff in the several technological divisions were deputed to experimental and problem blocks in the different liaison zones for execution of the programme of work.

Construction of Buildings

18. The constructional work at the Coffee Research Station, Balehonnur, was in charge of the Public Works Department of the Government of Mysore, as in the previous year. During the year, four senior staff quarters were completed and handed over to the Research Department in November, 1957. Work in respect of two more senior staff quarters and one twin quarters was in an advanced stage. Plans for the construction of administrative offices, extensions to the laboratory, mechanical workshop and farm stores were got approved and the execution of the same will commence in the coming season.

It must be admitted that the progress in this direction has been unfortunately slow and halting in spite of the very best efforts made by the Mysore Public Works Department. The difficulty of obtaining adequate skilled labour, the short period in which these works have to be taken and bottle-necks in transport and availability of material at nearby sources have all contributed to this delayed execution. The programme has been re-phased to ensure attracting reliable workers with proper inducement of remunerative work within that period. The next phase of

constructional works at the two Stations and the proposed Field Regional Stations during the period 1959-62 is under active consideration of the Research Committee.

19. At the Coffee Research Sub-Station, Chethalli, the construction of stores, power house and drying yard were completed during the year. The construction of the stores was in charge of the Minor Irrigation Department while the other works were done departmentally. The work in respect of the extensions to the laboratory was in an advanced stage while plans for farm stores, creche and staff quarters were prepared and got ready.

Library

20. During the year, 22 journals were newly added to the Library thus bringing the total number of journals subscribed to 78. Thirty journals were received on an exchange basis as against 18 in the previous year.

21. One hundred and one books were added to the Library during the year inclusive of seven received as gifts from individuals and institutions, thus bringing the total number of books in the library to 1,133. Fifty-two volumes of standard books of reference on soil management, fertilizers and plant protection were purchased and supplied to the offices of the Liaison Officers.

22. The officers and staff of the Research Department made full use of the increased facilities available in the library and over 800 volumes were issued to the staff for study and reference.

Meetings

23. I attended two meetings of the Board, two of the Executive Committee and two meetings of the Research Committee at Bangalore. An informal meeting of some members of the Research Committee was held at the Coffee Research Sub-Station, Chethalli, in September, 1957. I was co-opted as a Member on the Quality Control Committee and attended three meetings of that Committee. Besides, I attended three meetings convened in connection with the staff requirements of the Research Department by the *Ad Hoc* Committee, one for preparation of score card for assessing quality of coffee, the Soil Testing Officers' Conference and the Annual Conference of the United Planters' Association of Southern India at Coonoor. Two staff conferences of the officers of the technical and extension wings of the Research Department were held at the Coffee Research Station, Balehonnur, in November, 1957, and in June, 1958, to discuss and review the programme of research, extension and administrative matters and other cognate subjects. Informal discussions with the Heads of Technological Sections were held at frequent intervals, and with the Superintendent during visits to the Sub-Station, Chethalli. A conference of the divisional officers of the extension service was also held in March, 1958, to discuss matters connected with administration, jurisdiction, etc.

24. I addressed meetings of the Mysore Planters' Association and Indian Planters' Association, Chikmagalur, and Coorg Planters' Association, Mercara,

As a representative of the Coffee Board in the Pest Control Products Sectional Committee of the Indian Standards Institution, I attended two meetings of the Committee, one at Madras and another at Mysore.

Exhibitions and Conferences

25. A Field Day was held at the Coffee Research Station, Balehonnur, on the 13th and 14th November, 1957. There was a large concourse of visitors consisting of over 1,000 planters and 200 visitors representing connected industries. Visits to the experimental plots and discussions on several aspects of cultivation of coffee were held. The Research Department brought out a specially prepared brochure detailing the activities of the Station and an illustrated folder both in English and the regional languages of the 'dos' and 'dents' of systematic coffee cultivation. An Exhibition highlighting the activities of the Research Department was also held.

26. The Research Department participated in the U.P.A.S.I. Exhibition at Coonoor, the Dasara Exhibition at Mysore and the Malnad Agricultural Conference held at Mudigere. Representatives of the Research Department participated in the Annual Scientific Conference of the U.P.A.S.I. held at Coonoor in March, 1958, and the Indian Standards Institution Convention held at Madras in December, 1957.

Correspondence

27. With the increased tempo of the Liaison Services, the correspondence handled at the main Research Station shows an increase over last year. The number of advisory letters issued from the two Research Stations have also increased indicating the awareness of the planters to the day-to-day problems on coffee cultivation. The details of correspondence, both inward and outward, are given below:—

		Balehonnur		Chethalli	
		1956-57	1957-58	1956-57	1957-58
Inward	.. ..	15,515	17,562	3,420	3,015
Outward	.. ..	21,439	33,862	5,690	2,844

Budget

28. The budget provisions for the financial year 1957-58 anticipated a programme of expenditure of Rs. 3,15,700 under capital works and Rs. 8,21,300 under recurring expenditure inclusive of estate maintenance. An actual expenditure of Rs. 1,54,906 under capital charges and Rs. 7,00,372 under recurring charges was incurred during the same period. The considerable savings under capital expenditure were due to a slowing down of the constructional programme at the

Coffee Research Station, Balehonnur. The savings under recurring expenditure were mainly due to observance of strict economy in the various sections of the Department, the hardening import restrictions for purchase of equipment and not filling sanctioned posts. The details of the budget are furnished below:—

	Budget provisions for 1957-58		Actual expenditure for 1957-58	
	Capital	Recurring	Capital	Recurring
	Rs.	Rs.	Rs.	Rs.
Research and Extension ..	3,07,700	6,57,800	1,53,770	5,82,577
Development	8,000	1,63,500	1,136	1,17,795

29. The budget provisions for the year 1958-59 under both the Research and Development schemes are as follows:—

	Capital charges	Recurring expenditure
	Rs.	Rs.
Research and Extension ..	4,92,300	7,59,600
Development	3,000	2,13,000

The expansion of Liaison Services, starting of new projects, provision for construction of administrative offices and other buildings and the purchase of sprinkler irrigation units have all accounted for increased expenditure proposed by the Department.

30. The revenue receipts anticipated and actually realised for the year 1957-58 and the estimated receipts for the year 1958-59 are given below:—

	1957-58		1958-59 Estimated
	Anticipated	Actual	
	Rs.	Rs.	Rs.
Research and Extension	1,82,200	2,58,875	2,49,300
Development ..	75,000	38,348	40,000

The increased receipts under Research and Extension are due to a higher coffee crop at the Research Stations and increased sales of pedigree seed to the planters.

31. The audit of the accounts for the year 1956-57 of the two Research Stations at Chethalli and Balehonnur were conducted during December, 1957, and

February, 1958, respectively. The Accounts Officer of the Board also conducted physical verification of accounts in September, 1957, and February, 1958, respectively at the above two Stations.

Visits

32. The Coffee Research Stations at Balehonnur and Chethalli received over 1,000 planters and others interested in the planting industry. It was encouraging to note that the trend noticed in the past of groups of small planters visiting the Stations either with the Liaison Officers of their division or of their own accord continued in an increasing tempo. As many as a dozen batches of small planters numbering over 100 visited the Stations. Four batches of students of the Agricultural Colleges, Hebbal and Dharwar, visited the main Station during the year as part of their annual training in plantation crops. A batch of students from the Khadi Gramudyog Mahavidyalaya, Krishnarajapuram, Bangalore, also visited the Research Station.

33. The Stations were privileged to receive the following distinguished visitors:—

- (1) Dr. A. A. Bitancourt, Director, Division of Plant Pathology, Instituto Biologico, Sao Paulo, Brazil.
- (2) Dr. R. V. Tamhane, Indian Agricultural Research Institute, New Delhi.
- (3) Dr. L. A. Dean, Indian Agricultural Research Institute, New Delhi.
- (4) Dr. S. Raja Rao, Indian Standards Institution, Calcutta.
- (5) Mr. Ivor Bull, Suffolk, England.
- (6) Sri. K. Srinivasan, I.A.S. (Retd.), Chairman, Coffee Board.
- (7) Dr. S. Mukherjee, Director of Cinchona, West Bengal.
- (8) Hon'ble Sri. H. S. Rudrappa, Minister for Agriculture, Mysore.
- (9) Sri. P. K. Gupta, Asst. Horticulturist, Bombay State.
- (10) Sri. J. Banerji, Conservator of Forests, Kakinada, Andhra Pradesh.
- (11) Sri. K. M. Thomas, Retired Director of Research, Coffee Board.

The Research Department is indebted to the Hon'ble Minister, Mysore Government and the officers of the Union and State Governments for their visits to the Stations and the interest evinced by them.

Training in Coffee Culture

34. Under the scheme for the training of personnel in the methods of coffee cultivation, Sri. I. K. Lama, a nominee of the West Bengal Government and Sri. R. Subramaniam, a private candidate, were given training during the year. In addition, three members of the staff, who were newly recruited during the year, were given training in the farm and in the several technological sections for periods ranging from one to three months prior to their posting to the sections.

Exchange of Seed Material

35. Seeds of seven types of arabica and *Coffea rupestris* from Horticultural Crops Research Branch, Beltsville, Maryland, U.S.A.; *C. racemosa* from Portugal; seeds of *Schizolobium parahybum*, *Peptadenia macrocarpa*, and *Erythrina speciosa* from Brazil; cuttings of *Erythrina* sp. and seeds of *Acacia elata* from Munnar and seeds of *Albizia sumatrana* from Nilgiris were obtained during the year for trial at the Coffee Research Station, Balehonnur.

Publications

36. The following were the publications issued by the Research Department during the year:—

Scientific Articles

- (1) "Coffee Research—its place in the plantation industry"—by Dr. B. T. Narayanan, *Plantation Supplement, U.P.A.S.I.*, Coonoor, August, 1957.
- (2) "Control of green bug in coffee"—by C. K. Vasudevan and S. A. Raja Rao, *Indian Coffee*, November, 1957.
- (3) "Role of plant protection chemicals in the control of pests and diseases affecting coffee"—by K. V. George and B. T. Narayanan, *Indian Standards Convention*, December, 1957.
- (4) "Control of quality in coffee"—by N. G. Chokkanna and B. T. Narayanan, *Indian Standards Convention*, December, 1957.
- (5) "The coffee leaf miner, *Agromyza* (*Melanagromyza*)"—by C. K. Vasudevan, *Current Science*, January, 1958.
- (6) "Pests of coffee and their control"—by Dr. P. Somasekhar, *Indian Coffee*, June, 1958.

Popular Articles

- (1) "A brief review of the working of the Research Department for the year 1956-57"—*Indian Coffee*, October, 1957.
- (2) "Preparation of parchment using alkali"—*Indian Coffee*, 1957.
- (3) "How to control coffee stem borer"—by C. K. Vasudevan, *Indian Farming*, November, 1957.
- (4) "A brief note on the Field Day held at the Coffee Research Station, Balehonnur"—*Indian Coffee*, December, 1957.
- (5) "Processing for promotion of quality in coffee"—by Dr. B. T. Narayanan, *Indian Coffee*, January, 1958.
- (6) "Trends in the cultivation of arabica coffee on the Bababudangiris"—by G. I. D'Souza, *Indian Coffee*, July, 1958.

(7) *Coffee Cultivation in India*—

Chapters 1 and 2—April, 1958

„ 3 May, 1958

„ 4 July, 1958:

*Reports**Indian Study Team in British East Africa*—by Dr. B. T. Narayanan, Travelogue.Part 2—*Indian Coffee*, August, 1957.

Part 3 „ September, 1957.

Part 4 „ November, 1957.

Part 5 „ February, 1958.

Part 6 „ March, 1958.

In addition, monthly practical hints to planters, timely warning notes and brief abstracts from reports, bulletins and scientific journals dealing with coffee and related products were got published in the *Indian Coffee*. A guide to the Research Station, experimental plots and the estate at the Coffee Research Station, Balehonnur, and an illustrated folder entitled, “Progress in Production”, detailing the systematic and scientific cultivation of coffee were published on the occasion of the Field Day. The *Tenth Annual Report* of the Research Department of the Coffee Board was printed.

37. A brief note on the work done by the Research Department in 1957–58 was prepared and sent to the Ministry of Commerce and Industry, Government of India. A brief technical report on research work of the Department was also sent to the Ministry of Food and Agriculture, Government of India, and the Secretary, Indian Council of Agricultural Research, New Delhi.

Acknowledgements

38. It is my privilege to express my deep sense of gratitude and that of all members of the Research Department to the many planters who have so generously co-operated in the layout of various field trials and demonstration plots and given unstinted help in so generous a measure. I would in particular extend our grateful thanks to Messrs. S. N. Ramanna, R. Radcliffe, F. G. Foster, C. Primrose, M. C. Mathew, M. K. Jinachandran, K. M. Verghese Mapillai, U. K. Lakshman Gowda, W. Woodbridge, K. A. Aiyappa, G. M. Manjanathaya, J. L. Short and Col. W. A. Rahm. To Messrs. Kothari, Mehta & Sons Ltd., Consolidated Coffee Estates (1943) Ltd., CLAIM LTD., Anaparai Estates Ltd., Rajendra Coffee Estates Ltd., and Badra Coffee Estates Ltd., the Research Department and I are indebted for facilities afforded for experimental work.

39. I acknowledge with thanks the help rendered by the Head of the Plant Introduction Section, Horticultural Crops Research Branch, U.S. Department

of Agriculture, Maryland; Dr. Branquinho d'Oliviera, Estacao Agronomica Nacional, Portugal (through Dr. C. A. Krug, Tropical Crops Specialist, Agricultural Division, F.A.O., Rome); Dr. K. S. Venkataramani, Botanist, Tea Experiment Station, Devarshola, Nilgiris; the General Manager, Kannan Devan Hills Produce Co. Ltd., Kerala; and the Director Instituto Agronomico Do Estado de Sao Paulo, Brazil, for arranging supply of seeds and plants of coffee types and shade trees.

40. The Department is deeply grateful to the Indian Embassies and Consulate Generals in London, Hamburg, Amsterdam, New York and Switzerland, the Testing Houses and to Mr. C. R. Devonshire of the Coffee Board of Kenya for the great help and consideration shown to this Department in arranging and undertaking the quality tests. I cannot be sufficiently thankful to the proprietors, owners and others associated with the several estates and the curing factories for the trouble they have taken and the co-operation extended to the Department in preparing these samples and assisting us in these very important investigations.

41. To the Directors and staff of the Commonwealth Institutes of Entomology and Mycology, London; the Head of the Entomology Research Department, U.S. Department of Agriculture, Beltsville, Maryland; and Dr. M. A. Baseer, Department of Zoology, Aligarh University, my special thanks are due for identification of insect and mycological specimens sent by the Department from time to time. To many scientists in India and abroad, who exchanged publications and material, I am grateful. It is with gratification and pleasure, I record the very happy associations with many technological institutions and the Departments of Agriculture in Mysore and Madras. To the Director and the staff of the Central Food Technological Research Institute, Mysore, I am grateful for undertaking repairs to laboratory equipment from time to time.

42. I and my colleagues record with gratitude the kindness and consideration we have received from the members of the various committees of the Coffee Board. To the members of the Research Committee, I am particularly indebted. Their support and consideration have been as ever unfailing and a source of encouragement to me in my work.

43. I am deeply grateful to Sri. K. Srinivasan, I.A.S. (Retd.), Chairman, Coffee Board, for his kindness, consideration and the unfailing interest and the valuable guidance he has extended to me and the Department.

44. To the planting community who have willingly placed at the disposal of the Department their knowledge and enthused us in the solution of their many problems and for their traditional generosity, hospitality and consideration to myself and the members of the Research Department, I extend my deep sense of appreciation and gratitude.

45. To the various grades of technical, executive and ministerial services at the two Research Stations and in the Liaison Divisions, I cannot be sufficiently grateful. They have borne cheerfully the brunt of work by their unstinted hard work and ever willing co-operation.

46. Brief reviews of the work done in the estates and in the different Liaison and Scientific Divisions together with detailed Sectional Reports are given in the following pages.

B. T. NARAYANAN,
Director of Research.

PART II

REPORT ON THE WORKING OF THE ESTATES AT THE COFFEE RESEARCH STATION, BALEHONNUR, AND COFFEE RESEARCH SUB-STATION, CHETHALLI

There were no changes in the staff of the Farm Sections and Sriyuths T. H. Thimme Gowda and C. Ramakrishnan Nambiar continued as Farm Assistant, Balehonnur, and, Superintendent, Coffee Research Sub-Station, Chethalli, respectively. The technical and ministerial staff attached to these sections were on leave for short periods during the year.

Season and Climate

2. The Coffee Research Station, Balehonnur, received a total rainfall of 134.65 inches on 149 rainy days as against 105.10 inches received on 156 rainy days for the corresponding period in the previous year and against 111.65 and 104.64 inches being the averages for the past ten and thirty-one year periods respectively. Thus the rainfall during the year was in excess of that of last year by 29.55 inches and the ten year's average by 23.00 inches. The rains were fairly well distributed during the year.

3. The South-West Monsoon of 1957 set in early by the last week of May and strengthened by the middle of June. The months of July and August continued to be the wettest months, the total precipitation received during the two months being 60.39 inches. The monsoon weakened by the last week of August, and, the month of September was fairly sunny. After an incipient start in the first week of October, the North-East Monsoon strengthened by about the third week of the same month and weakened by the middle of November. The precipitation was, however, uniformly distributed during the period. After the cessation of the monsoons, a fairly long dry period of 130 days was experienced and the first summer showers were received on 26th March, 1958. The blossom showers for the year 1958 were received early in the season but backing showers were belated. However, the even and steady showers received during the latter half of April, helped in the better development of the crop. The monsoon for the year set in by the middle of June, 1958, and continued to be very active during the months of July and August.

4. At the Sub-Station, Chethalli, a total rainfall of 75.78 inches was received during the year as against 74.12 inches for the corresponding period in the previous year and against 68.87 inches being the average for the past ten years. An even distribution of rains throughout the major part of the year and a dry period extending from December to March helped considerably in the recovery of the coffee bushes. An incipient shower of 0.57 inches in the last week of March 1958 did not help in bringing forth a good blossom but on the other hand resulted in the

paddying of as high a percentage as 30 of the spikes. The regular blossom showers were received in the second week of April and the backing showers were adequate and helpful.

Incidence of Diseases and Pests

5. At the Coffee Research Station, Balehonnur, the incidence of leaf disease during the early part of the South-West Monsoon of 1957 was practically negligible. The bright breaks during September and ideal conditions existing in the early part of the North-East Monsoon period helped in the rapid dissemination and spread of the disease. Though the intensity of infection was not very marked, defoliation of leaves started by December and continued till the end of January. The intervening dry period and the rather thorough defoliation resulted in a small carry over of the disease. Consequent to the fairly well distributed and extended summer showers, a slight spread of the disease was, however, noticed. The continued flushing of the bushes necessitated a tip spray during May in addition to the usual pre-monsoon Bordeaux spraying. The fairly heavy rains during the months of July and August acted as a check on the spread of the disease. However, in view of the successive flushing of the bushes, it is expected that towards the close of the monsoon, the build up of the disease is likely to be considerable necessitating timely post-monsoon spraying.

6. The incidence of black rot was practically absent during the year except in portions of the endemic blocks R, E and G-5. Damping off and collar rot of seedlings in the germination beds as well as in the bed and basket nurseries were at a minimum. However, the incidence of brown eye spot was fairly widespread in the nursery and young clearings.

The seasonal conditions were favourable and though considerable defoliation occurred during June-July of this year, the plants have been in relatively good condition due to the continuous flush of new growths. Immediate attention to handling of diseased material, timely regulation of shade and phytosanitary measures as part of the routine cultural operations in the estate and in the nursery have been responsible for the low incidence of the above maladies.

7. The incidence of stem borer during the year was 0.6 per cent. as against 0.5 per cent. in the previous year. The regular programme of rigid tracing of borer affected plants and application of B.H.C. during the flight periods have been responsible for effectively keeping the pest in check. The incidence of green bug was also low during the year due to the activity of insect parasites and pathogenic fungii. The shot-hole borer on robusta, on the other hand, was on the increase and maximum infestation was noticed during the dry months of November and December. The red borer assumed pest proportions during the year and was found causing damage to young plants. Minor pests like leaf-eating caterpillars, leaf-miners, weevils, etc., did not present any serious problem.

8. At the Coffee Research Sub-Station, Chethalli, the leaf disease situation continued to be mild during the period under report. Timely spraying helped

to a great extent in arresting the spread of the disease. The carry over of healthy leaves throughout the year was appreciable. Regular tracing of borer affected plants and timely plant protection measures continued to pay good dividends. A small outbreak of red borer in young clearings was noticed. The incidence of green bug and other pests and diseases of coffee were at the minimum.

Area—Replanting and New Clearing

9. The area under coffee in the two Stations are:—

	Planted area (in acres)		Bearing area (in acres)	
	Arabica	Robusta	Arabica	Robusta
Balehonnur	111.74	31.76	85.01	29.00
Chethalli	110.76	10.04	85.77	4.96

10. An area of 1.25 acres of old coffee uprooted at the Coffee Research Station, Balehonnur, in the previous year was planted to varieties and species of coffee imported from other countries as well as those obtained from estates within the country. An area of two acres of jungle was cleared and one acre of the same was planted to progenies of outstanding plants of Station Selections. In addition, an acre of robusta in the rubber area was top-worked to arabica scions with a view to study the possibilities of conversion of bearing robusta and to serve as a visual demonstration of the method. There were no new clearings or replanting of coffee during the year at the Coffee Research Sub-Station, Chethalli.

Crop

11. The yield of uncured coffee harvested during the year is as follows:—

	Yield of Coffee in Bushels (uncured)				
	Balehonnur			Chethalli	
	Arabica	Robusta	Tree coffee	Arabica	Robusta
A. Parchment	825-17	497-22	..	2,107- 1	75-16
B. Cherry	634- 0	273- 7	82- 7	1,415- 0	96- 0
C. Gleanings and bits	119- 0	54- 0	..	285- 0	3- 0
D. Others including seed coffee	140-20	90- 3	0-11	126-21	..
TOTAL ..	1,719- 9	915- 4	82-18	3,933-22	174-16
Yield of clean coffee in tons	17	9.5	0.5	37	1.75

12. A crop of 17 tons of arabica, 9.5 tons of robusta and 0.5 ton of tree coffee aggregating to 27 tons was harvested during the 1957-58 season as against an estimate of 16, 6.5 and half a ton arabica, robusta and tree coffee respectively, at the Coffee Research Station, Balehonnur. The crop prospects for the year 1958-59 are estimated at 20 tons of arabica, 11 tons of robusta and half a ton of tree coffee.

13. At the Coffee Research Sub-Station, Chethalli, a crop of 38.75 tons was harvested during the year as against an estimate of 46 tons on the blossom. The crop estimates for the year 1958-59 are placed at 30 tons.

Seed Distribution

14. The zonal seed plots in private estates were continued to meet the increasing demand for seeds of the major Station Selections. Eight estates in Mysore Zone and one on the Nilgiris co-operated in the establishment of these seed plots. Seed coffee was prepared under the strict supervision of the Research Department. The quantity of seed collected from these blocks as well as from the two Research Stations is given below:—

Source of seed supply	Quantity of seed coffee prepared in lb.		
	Arabica	Robusta	Total
Coffee Research Station, Balehonnur	1,346	854	2,200
Coffee Research Sub-Station, Chethalli	4,712	..	4,712
Regional Seed Blocks	8,105	..	8,105
TOTAL ..	14,163	854	15,017

15. A total quantity of 13,504 lb. of arabica, 814 lb. of robusta and 14 lb. of tree coffee seeds were sold to 2,529 planters during the year 1957-58 as against 13,397 lb. of arabica, 341 lb. of robusta and 26 lb. of tree coffee seeds distributed to 2,034 planters in the previous year.

	Seeds distributed in lb. during		No of planters supplied	
	1956-57	1957-58	1956-57	1957-58
Arabica selections	13,397	13,504	2,034	2,529
Robusta selections	341	814		
Tree Coffee	26	14	..	..

16. Twenty-two pounds of seeds of arabica selections were supplied during the year to (a) the Senior Research Officer, Coffee Research Station, Department

of Agriculture, Ruiru, Kenya, (b) the Hon'ble Minister for Agriculture, Government of Viet Nam; Saigon, (c) the United States Operation Mission, Laos, (d) the United States Technical Co-operation Mission, American Embassy, Taiwan, Formosa, and (e) the Chinese National Tea Export Corporation.

Paddy and Other Crops

17. Paddy was grown over an area of 1.67 acres at Balehonnur and 6.0 acres at Chethalli. The Japanese method of cultivation was followed. The following quantities of grain and straw were obtained:—

	Area in acres	Yield of grain in lb.		Yield of straw in lb.	
		1956-57	1957-58	1956-57	1957-58
Balehonnur ..	1.67	2,808	3,235	5,100	7,350
Chethalli ..	6.00	14,181	15,072	9,867	9,500

18. The orange crop at Chethalli though good was not as encouraging as in the last year. A sum of Rs. 7,336 was realised against Rs. 11,557 obtained in the previous year. The prospects for the coming year are fair.

Miscellaneous

19. Both the Stations continued to be members of the United Planters' Association of Southern India and the Regional Planters' Associations. The Sub-Station was also a member of the Coorg Orange Growers' Co-operative Society.

20. The labour strength at Balehonnur which was 140 at the end of last year closed with 159 at the end of the year against a sanctioned strength of 170. The average labour outturn was 73.6 per cent. against last year's outturn of 62.6 per cent. At Chethalli, the labour strength remained stationary at 107 throughout the year against the sanctioned strength of 130. The average outturn of labour was 90 per cent. against 86.60 per cent. in the previous year. The employer-employee relationship continued to be cordial and happy at both the Stations. The Independence Day, the Republic Day and the Centenary Celebrations were observed at both the Stations. The mazdoors were granted holidays with wages on these days and entertained to sports and refreshments.

21. The two Stations continued to have their own arrangements for water supply. The Main Station continued to enjoy the power supply from the State Electricity Department. The generator released from Balehonnur was commissioned at Chethalli and power was made available from March, 1958.

22. A canteen was run at Balehonnur for the benefit of the mazdoors. The creche for the children at Chethalli continued to be maintained. Milk for babies and mid-day meals for non-working children were provided. A radio was working

at each of the Stations. Screening of films of technological and rural interest was arranged for the benefit of the staff and the mazdoors, and four were shown during the year. The service of the cart was made available for conveying the school-going children at the Sub-Station, Chethalli, to the higher elementary school at the tenth mile, a distance of one mile from the Station.

B. T. NARAYANAN,

Director of Research.

PART III

EXTENSION SERVICE

I was in charge of the direction and supervision of the Extension (Liaison) Service throughout the year under report.

2. During the year, the jurisdictions of the Senior Liaison Officers were realigned with effect from April, 1958, with a view to increase the usefulness of the advisory services, streamline their activities and to make the divisions comprehensive and well-knit administrative units. The statement below shows the several liaison divisions, their jurisdiction and the officers in charge of the same:—

North Mysore Liaison Division	Liaison Districts of Chikmagalur, Mudigere and Saklespur. Headquarters—Saklespur.	Sri. B. K. Chandrappa
South Mysore Liaison Division	Liaison Districts of North Coorg, South Coorg and North Kerala (Wynaad). Headquarters—Somwarpet.	Sri. G. I. D'Souza
Coimbatore Liaison Division	Liaison Districts of Pulneys, Nilgiris and coffee areas in Anamallais, Nelliampathies and former Travancore-Cochin State.	Sri. T. V. Pattabhiraman

The old Mudigere District was bifurcated and a new Liaison District called the Koppa Liaison District was constituted consisting of estates in the Koppa-Sangameswarpet and Magundi Sections. This was placed in charge of Sri. W. Raghavendra Rao, Senior Liaison Officer (Development), Balehonnur. The coffee areas in the North-East and South-West Monsoon zones of the Nilgiris revenue district of the Madras State were constituted into a new Liaison District and placed in charge of a Junior Liaison Officer with headquarters at Coonoor.

3. In response to repeated requests from planters in South Kerala area for advice regarding opening of new areas and extension of coffee cultivation, an intensive survey of this area has been undertaken with a view to assess the possibilities of growing coffee.

4. It is understood that coffee introduced as pilot projects under the shifting cultivation scheme in forests and tribal areas of Assam State has extended to over 200 acres. Four pilot projects of five acre blocks each were recommended to be started in the Cinchona plantations near Darjeeling after Officers of the West Bengal

Government had visited the coffee areas in South India and held detailed discussions. The Research Department has also planned for visits to these areas to assess their suitability or otherwise for coffee cultivation. This Department has agreed to offer technical help for improving and extending the area under coffee in the Agency tracts of Visakhapatnam and East Godavari Districts of the Andhra Pradesh State. Based on the recommendations of the Special Officer, Government of India, for the Development of Coffee Industry, the Department of Agriculture, Mysore, has selected four places for locating test trial plots in the North Kanara District and have approached this Department to undertake spot studies and offer technical opinion regarding the suitability of sites.

5. I toured the liaison areas of Mysore, Coorg, Shevaroy, Nilgiris, Wynaad and Pulneys. During my tours in the several Liaison Districts, planters, both big and small, were contacted and problems, individual as well as zonal, were discussed. Advantage was taken of these visits to assess the performance of Station Selections with particular reference to their growth characteristics, the incidence of pests and diseases in the nursery and post-nursery stages, their response to blossom showers and yield performance. *Inter alia* the quality of the crop of the several Station Selections and other commercial growths formed part of an intense study. Suitable sites for locating the field regional stations were inspected.

Development Plan

6. The Schemes for the supply of disease resistant, pedigree seeds of Station Selections, organisation of co-operative pulping units and the accelerated programme of demonstration of improved techniques of cultivation under the Coffee Development Plan continued to be under the direct charge of the Research Department. A brief review of the progress of work in respect of the above schemes is given below.

7. The seed coffee requirements were obtained from the two Research Stations at Balehonnur and Chethalli and from nine registered seed blocks located in private estates. During the year a total quantity of 14,332 lb. seed coffee was supplied to 2,529 growers as against 13,764 lb. to 2,034 planters during the 1956-57 season. The yearly distribution of seed coffee from the year 1948-49 to date and the number of planters to whom supplied and the distribution of seed coffee liaison district-wise are given in Appendices 2 and 3.

8. The co-operative pulping unit established at Mallandur in Chikmagalur District in 1955-56 completed another successful season during the year 1957-58. A quantity of 2,270 imperial bushels of fruit was converted into parchment as against 1,923 and 732 bushels in the years 1956-57 and 1955-56 respectively. A second co-operative pulping unit came into operation at Hosallipet, Chikmagalur District, during the year and a total of 2,569 bushels of fruit was converted into parchment. Active assistance for the starting of four more co-operative pulping units in Chikmagalur, Mudigere, Saklespur and North Wynaad liaison zones was given.

9. The establishment of the above co-operative pulping units has made many small- and medium-scale planters parchment-minded. As a result of this, as many as six new individual pulping units have been installed in such holdings in Mallandur area and the departmental help sought for the establishment of 15 more units during the next season.

10. A total of 77 demonstration, re-orientation, cultural, plant protection and manurial trial plots were newly laid during the year 1957-58, thus bringing the total number of such plots to 317. A list of the plots in the several Liaison Districts is furnished in Appendix 4. It has been observed that in the course of 2 to 3 years these plots have been in operation, the yields have been stepped up from the pre-demonstration 0.5 cwt. level to 3 to 5 cwt. per acre. This has naturally resulted in many of the medium and small-scale planters taking up to the recommended calendar of operations of their own volition. Subsidised demonstration plots where production levels have been stabilised at 5 to 8 cwt. per acre due to adherence to a scheduled calendar of operations over the past two to three years have been converted into non-subsidisable re-orientation plots and new demonstration plots are being opened in other areas requiring attention. A total of 103 estates which received loan aids under the Development Plan also came under the purview of the departmental intensive advisory services. Suitable calendars of operations, keeping in view the peculiarities of the zone and the estate have been issued and regular follow up visits made to these estates to assess the progress made. The list of loan aided estates liaison zone-wise is given in Appendix 6.

11. Practical demonstrations of the various cultural, manurial, agronomical and plant protection practices formed the main plank of departmental advisory activity. Three hundred and twenty such demonstrations were held during the year and 1,418 planters participated in the same. One hundred and seventy-eight gatherings of planters were also addressed on various aspects of coffee cultivation. A Field Day was held at the Coffee Research Station, Balehonnur, in November, 1957, to bring the planting community in closer contact with the Research Department. Over 1,000 planters attended the same.

12. The tempo of advisory correspondence was sustained and enlarged as may be seen from as many as 16,000 advisory notes issued from this Department as against 15,000 issued in the previous year. A brief review of the work done in the several Liaison Divisions and Districts is presented below:—

North Mysore Liaison Division

13. Sri. G. I. D'Souza continued to be in charge of the North Mysore Division till 16-4-1958 when he was transferred to the charge of the South Mysore Division. Sri. B. K. Chandrappa assumed charge of the newly constituted division from 17-4-1958. Sri. H. A. Krishnamurthy, Liaison Assistant, was transferred to Somwarpet on 26-4-1958 and Sri. K. R. Ahobala Rao was posted in his place. The latter was transferred to Chikmagalur on 25-7-1958 to attend to the current duties of the Junior Liaison Officer, Chikmagalur. Sri. M. Narahari,

Research Assistant, posted under the Development Scheme, continued to work on the special project on nursery and post-nursery diseases.

14. The rainfall and climatic conditions were fairly satisfactory. The belated receipt of blossom showers and subsequent none too favourable weather conditions marred the prospect of an otherwise bumper crop in the division and especially so in the Saklespur zone. The leaf disease was at its minimum.

15. The Senior Liaison Officer was on tour for 237 days, visited 300 estates and contacted an equal number of planters. He addressed 22 gatherings of planters, conducted 15 demonstrations on improved plantation techniques and gave advice to 190 growers both in person and by post. The co-operative pulping unit at Mallandur worked satisfactorily for the third year in succession while the one at Hosallypet began functioning with a good start. Efforts were under way to organise five more such units in the division.

Chikmagalur Liaison District

16. Sri. H. Hanumantha Rao, Junior Liaison Officer, continued to be in charge of the post till 26-8-1957 when he was transferred to Kalpetta. Sri. G. I. D'Souza was in additional charge of the post till 31-10-1957 when Sri. S. J. Mathias reported for duty. The latter was in turn relieved, consequent on his transfer to Dindigul, by Sri. H. S. Puttuswamy on 2-6-1958. Sri. H. S. Puttuswamy proceeded on earned leave for 12 weeks from 7-7-1958 and the Liaison Assistant was placed in charge of the current duties from 21-7-1958.

17. The monsoon during the year was more than the average except in eastern portions of the Giris. The favourable seasonal conditions extending over a major area of the tract was reflected in the highest ever crops picked in many of the estates. The blossom showers for the coming crop were indifferent and patchy; the backing showers were generally satisfactory.

18. The incidence of white stem borer and green bug was negligible. Red borer and cercospora were reported from a number of estates but were kept in check by timely and proper plant protection measures. Increased damage to coffee and shade trees by hairy caterpillars was reported from estates this year also. Mechanical and chemical control measures instituted at the proper time have kept the pest under control. The leaf disease has in general been less severe during the year.

19. A quantity of 1,052 lb. seed coffee of the major selections was distributed to 127 growers during the year as against 1,721 lb. seed coffee to 174 planters in the previous year. The demand for seed from Station Selections, especially S. 795, is on the increase.

20. There was no change in the number of demonstration, re-orientation and differential manurial blocks in the zone. However, three demonstration plots where the production levels have stabilised at 5 to 6 cwt. level have been converted into non-subsidised ones and three new ones were started in their place in

such parts of the zones which did not have these before. The two field manurial trials at Togarihankal and Bynecool, the six varietal trials in private estates and the four plant protection trials for the control of stem borer and green bug and prevention of leaf fall and fruit shed were continued.

21. He was on tour for 206 days, visited 260 estates, contacted 280 planters and addressed 13 meetings of planters, both big and small. Forty demonstrations of improved plantation practices were conducted and advisory letters totalling 300 were issued on problems of rehabilitation, manurial and cultivation practices and plant protection measures. He also visited 12 estates for assessing the value of these in connection with the sanction of grant-in-aid loans. Twenty loan aid estates which came under the purview of intensive cultivation were issued detailed calendar of operations and follow up visits were made to assess the progress of work.

Mudigere Liaison District

22. Sri. H. S. Puttuswamy continued to be in charge of the District till 26-5-1958, when he was transferred to Chikmagalur. Sri. K. T. Bhagath took over charge from 27-5-1958 and held charge of the District for the remaining part of the year. During the middle of April, 1958, estates situated in Koppa-Sangameswarpet-Magundi section extending over an area of about 16,000 acres, were separated from the Mudigere Liaison District and constituted into a new liaison zone.

23. The South-West Monsoon started very early during the year but weakened by the end of July and sub-normal conditions with intermittent showers and bright breaks prevailed. The North-East Monsoon, on the other hand, was characterised by heavy and continuous precipitation. However, the seasonal conditions were fairly normal and crops exceeding 10 to 15 per cent. of the blossom estimates were picked in a number of estates. The blossom showers for the 1958-59 crop were received early but were light. But a good precipitation of over an inch early in April followed by adequate backing showers assure the prospects of a good crop.

24. The incidence of leaf disease was mild due perhaps to the prevailing weather conditions, low carry over of the infection and timely spraying of Bordeaux mixture. Black rot was negligible except in parts of Kalasa and Banakal and was kept in check by handling of diseased material and spraying with 1 per cent. Bordeaux mixture. Though collar rot and cercospora were noticed in the nursery, they did not assume serious proportions. The incidence of white stem borer and green bug was at the minimum. Instances of red borer incidence on arabica were received from a few estates from Doddengudda, Makonhally, Bettadamane and Gonibed areas. The damage was noticed to be more severe in young clearings and maximum damage was noticed in the dry months following the monsoon. The infestation of shot-hole borer, on the other hand, was fairly severe in Hirebyle, Aldur and Banakal areas. Timely plant protection and cultural measures were advocated for the control of the above pests.

25. During the year, 3,420 lb. improved seed material was distributed to 416 growers as against 3,143 lb. to 499 growers in the previous year. The performance of Station Selections in general has been very encouraging. The Station Selections were relatively free from post-nursery diseases. Plants at cropping stage also did not suffer by loss of spikes due to receipt of small blossom showers.

26. The number of demonstration, re-orientation and differential manurial plots in existence at the end of the last year were increased by the addition of six more blocks. Three demonstration plots which have served the purpose by stabilising at higher yield levels were converted into re-orientation blocks and three opened in new areas. The modified robusta manurial trial in Banakal estate, the six explanatory-cum-varietal trials, and the seven plant protection trials laid in private estates in the previous years, were continued.

27. He was on tour for 222 days, visited 500 estates, big and small, contacted an equal number of planters and addressed 63 gatherings of planters. Six demonstrations of improved cultivation practices were conducted. Advisory correspondence totalling 300 were attended to. Sixteen estates were visited in connection with the sanction of grant-in-aid loans. Thirty-five loan aided estates were brought within the scope of intensive advisory services and calendar of operations were drawn up for their guidance and adoption. Follow up visits to these estates for watching their progress formed an important feature.

28. Arrangements were made for the collection and export of bulk samples of Station Selections and other commercial growths from five estates. A total quantity of 2,400 bushels were thus sent to the curers for curing and despatch to foreign markets for study of market reaction.

Saklespur Liaison District

29. Sri. H. T. Ranga Setty continued to be in charge of the post for the major part of the year under report. He was transferred on 26-7-1958 as Special Officer for testing of proprietary products and the Senior Liaison Officer held additional charge of the post for the rest of the year. Sri. L. Raju, Liaison Assistant, was transferred to Coimbatore Division on 16-9-1957.

30. The rainfall during the monsoons of the year 1957 was normal. The blossom showers for the 1958-59 crop were received during March-April. Though the quantum of rains was adequate for opening of flower-buds, running blossom was noticed in most of the estates, due perhaps to the peculiar seasonal conditions prevailing in those months. The month of March was very hot while in April, after the receipt of blossom showers, days were characteristically dull and cloudy. This has resulted in poor setting and defective development of the crop. A crop of about 4,000 tons is estimated to be picked in the coming season.

31. The incidence of white stem borer, red borer and green bug was at a minimum. Eelworm has so far been found confined to some few estates. The leaf disease was almost negligible in most of the estates in the zone. On the other

hand, cercospora was found to be a major problem in the nursery and new clearings. Periodical spraying and maintenance of phyto-sanitary conditions helped to a great extent in keeping this malady under check.

32. A total quantity of 1,418 lb. seeds of Station Selections was distributed to 215 growers as against 1,623 lb. seeds to 206 planters in the previous year. The Selections S. 795, S. 288, S. 947 and S. 952 were found to be popular in the zone. The first two are popular in major parts of the zone while S. 947 is popular round about Ballupet. In the heavy rainfall areas of Hanbal and Devarunda, S. 952 is in great demand.

33. Eleven demonstration plots, one re-orientation plot and four differential manurial plots were newly added during the year thus bringing the total number of such plots to 26. The eight field manurial trials with arabica and robusta in Karadibetta, Sulgode, Cheekanahally, Ossoor and Harley estates, the five varietal-*cum*-exploratory trial plots and the five plant protection trials against stem borer and eelworm were continued.

34. He was on tour for 238 days, visited 560 estates, contacted over 700 growers, both big and small, and participated in 10 meetings and group discussions of planters. Five demonstrations on improved plant cultivation practices were conducted. Advisory correspondence totalling 130 were issued on routine matters of coffee cultivation, soil and manurial practices and plant protection measures. Six applications for the grant of loans were disposed off after spot inspection of estates. Sixteen estates that received loans were taken up for intensive working and calendar of operations were drawn up. This was followed up by frequent visits to these for watching the progress made.

South Mysore Liaison Division

35. Consequent on the reallocation of the jurisdictions of the Senior Liaison Officers, Sri. G. I. D'Souza was transferred from Chikmagalur to Somwarpet, to be in charge of the South Mysore Liaison Division comprising North Coorg, South Coorg and North Kerala (Wynaad) Liaison Districts. He assumed charge of the division from 26-4-1958. Sri. H. A. Krishnamurthy, Liaison Assistant, who was transferred from Saklespur joined duty on 2-5-1958.

36. Leaf disease occurred in a mild form on the Nilgiris (Wynaad) while the incidence of stem borer on arabica was negligible. Economic damage due to the green bug was noticed in a few estates in Coorg but was effectively kept under check by timely plant protection measures. The damage due to shot-hole borer on robusta increased in Malabar-Wynaad but was brought under control by adopting suitable preventive methods. It was noticed that the eelworm was found slowly spreading to other estates round about Coovercolly and Cottanad.

37. Arrangements were in an advanced stage for the opening of two co-operative pulping units, one at Madakimala in Wynaad and another near Somwarpet,

38. The site for the South Coorg Field Regional Station at Gonicoppal, was taken over during the year and an area of two acres was cleared and planted to Selections of arabica and robusta. Estimates for the construction of buildings, and fencing the area were prepared and got ready. The site belonging to Messrs. Kottaram Plantations near Kalpetta has been finally selected for the Field Regional Station, North Kerala (Wynaad). Negotiations are in an advanced stage for the acquisition of the land.

39. The Senior Liaison Officer was on tour for 60 days and visited 68 estates and contacted an equal number of planters. He gave advice to over 200 planters both in person and by post.

North Coorg Liaison District

40. Sri. K. T. Bhagath continued to be in charge of the District till 26-4-1958 when he was transferred to Mudigere. Sri. G. I. D'Souza, Senior Liaison Officer, was in additional charge of the post for the rest of the year. The post of Junior Clerk remained vacant for a major part of the year.

41. The seasonal conditions during the year were rather abnormal. The total rainfall received was above average and the highest ever recorded so far. Rains were received practically throughout the year and the intervening dry period was characteristically short. The blossom showers during 1958 were received in the second half of March but were not widespread and localised. However, the backing showers were adequate and fairly well spread in all parts of the zone. The crop prospects for 1959 are very encouraging and it is very likely that a bumper crop of over 8,000 tons may be picked.

42. The incidence of leaf disease and black rot was negligible during the year. The damage due to the white stem borer was also at the minimum. A few cases of outbreak of green bug were reported in new clearings, but the pest was brought under control by timely spraying with insecticides. The shot-hole borer on robusta was fairly widespread in Murnad and Bhagamandla areas. Thinning of shade and removal of affected twigs were advocated for the same. Sporadic outbreaks of red borer and eelworm were reported from a few estates and suitable remedial measures were suggested.

43. During the year, a total of 1,362 lb. seeds of Station Selections were distributed to 279 growers as against 2,346 lb. to 475 planters in the previous year. A study of the performance of the arabica Station Selections showed that these were comparatively free from derogatory factors like leaf disease, die back and shanking off of berries. It was also noticed that these do not suffer very much due to receipt of small quantities of blossom showers.

44. Three demonstration plots which had outlived their usefulness as visual demonstration centres in view of their having stabilised at higher yield levels were converted into non-subsidised re-orientation plots. The total number of demonstration, re-orientation and other plots at the end of the year was 13 as against 12 in the previous year. The field manurial trial at Malamby, the four exploratory-

cum-varietal trials and the insecticidal trials against stem borer and eelworm were continued.

45. He was on tour for 230 days, visited 388 estates, contacted 584 planters and addressed two gatherings of planters. Advisory correspondence totalling 48 on matters pertaining to different aspects of coffee cultivation was attended to. Seventeen applications for the sanction of grants-in-aid loans were disposed off after inspection of the estates. Twenty-five loan aided estates were brought within the purview of intensive cultivation and calendar of operations were issued for their guidance and adoption. Follow up visits to these estates were also made to assess the progress made.

South Coorg Liaison District

46. Sri. R. Vijaendraswamy continued to be in charge of the District during the year under report excepting for a period of 25 days when he was away on earned leave. The headquarters of the District was changed from Chethalli to Gonicoppal with effect from 12-3-1958.

47. The seasonal conditions during the year were satisfactory. The monsoon rains were above normal and were received practically over nine months in the year with a short dry period. Though scattered summer showers were received by the end of March, the regular blossom showers occurred by the middle of April followed by timely and adequate backing showers. The crop prospects for the coming year are very encouraging.

48. The incidence of common pests and diseases affecting coffee was very low. The shot-hole borer on robusta attained pest proportions in a few estates and handling and cutting of affected twigs and shoots was recommended. The eelworm infection round about Cottanad and other estates is slowly spreading and seedlings in the nurseries from the above estates were also exhibiting damage due to the pest. The Kondlie disease in the nursery resulted in heavy mortalities ranging from 8 to 12 per cent. Suitable control measures were suggested.

49. A quantity of 3,222 lb. seeds of Station Selections were distributed to 847 planters during the year as against 1,650 lb. to 361 growers in the previous year. The Selections were found to be quite popular with the planters in view of their vigorous and healthy growth, normal development of berries and high yields even from an early age.

50. Four demonstration plots were newly laid during the year thus bringing the total number of blocks under demonstration, re-orientation etc., to 21. The two modified robusta field manurial trials at Yemmegundi and Huvinkadu and the three plant protection trials against stem borer and eelworm were continued.

51. He was on tour for 170 days, visited 335 estates, contacted 812 planters and addressed 96 gatherings and associations of planters. The number of demonstrations on improved plantation practices conducted during the year amounted to 190. The total number of advisory correspondence disposed off was 486. One

hundred applications for the sanction of grant-in-aid loans were disposed off and 62 valuation reports were furnished. Calendar of operations were issued to 19 estates and 29 follow up visits made to assess the progress.

North Kerala (Wynaad) Liaison District

52. Sri. S. J. Mathias continued to be in charge of the zone till 3-9-1957, when he was transferred to Chikmagalur. Sri. H. Hanumantha Rao took charge of the zone from that date and continued to be in charge of the post for the rest of the year except for a period of 75 days when he was away on earned-cum-medical leave. During this period, Sri. K. Haridas Menon, Liaison Assistant, was in charge of the current duties of the post. Sri. K. Haridas Menon was posted for survey work in South Kerala from 9-7-1958 and continued to work in that capacity for the rest of the year.

53. The seasonal conditions during the year were fairly satisfactory. The rainfall was generally above normal throughout the zone and the rains were spread over all the months excepting February. The summer months of 1958 were also unusually wet. The blossom showers for the 1958-59 season were spread over from January to March. Adequate and timely backing showers were received and the crop prospects for the coming year are very bright.

54. The incidence of shot-hole borer on robusta showed an upward trend during the autumn of 1957 but was kept under control by thinning of shade, cutting and burning infested shoots and twigs and adequate feeding of the bushes. The white stem borer and leaf disease occurred in a mild form on the Nilgiri Wynaad. Nurseries from a few estates in Meppadi area reported infestation by celandworm and were under examination.

55. A quantity of 942 lb. seeds of Station Selections was distributed to 101 growers as against 1,439 lb. seed to 141 planters in the previous years. Growth and general performance of the Station Selections were very satisfactory. The plants made very rapid growth attaining topping heights in the course of 8 to 9 months and put forth 8 to 12 pairs of primaries in the same period. Pronounced early cropping tendencies were also exhibited.

56. Six demonstration blocks were newly added during the year thus bringing the total number of demonstration, re-orientation blocks, etc., to 28. The four robusta manurial trials, the two modified manurial trials on robusta, the four exploratory-cum-varietal trials and the trial to find out the efficacy of different pesticides for the control of stem borer on arabica coffee were continued.

57. He was on tour for 263 days, visited 465 estates, contacted 985 planters and addressed 23 gatherings of planters. Thirty-seven demonstrations on improved plantation practices were conducted. The number of advisory services attended to in person and by post was 321. Eleven estates were visited for the sanction of grant-in-aid loans. One estate which received loan aid was furnished with a calendar of operations and follow up visits were made to assess the progress.

Coimbatore Liaison Division

58. Sri. T. V. Pattabhiraman continued to be in charge of the division during the year under report except for a period of 37 days when it was held in additional charge by the Junior Liaison Officer, Nilgiris, during the absence of the former on leave. He held direct charge of the coffee areas on the Nilgiris, Anamallais, Nelliampathies, Tirunelveli-Kanyakumari Districts, Biligiris and the coffee areas of Travancore. The Nilgiris District was constituted into a new Liaison District and placed under the charge of a Junior Liaison Officer from 13-6-1958. He held supervisory charge of the Liaison Districts of Pulneys and Wynaad. The latter was transferred to the control of the Senior Liaison Officer, South Mysore Division, from the middle of April, 1958. He also held supervisory charge of the Shevaroy's Liaison District for a period of three months.

59. Seasonal conditions on the Nilgiris were slightly more than usual. The North-East Monsoon rains were heavy and comparatively heavy precipitation was also received during the winter months of January to March. This resulted in continuous flushing of the bushes. The rainfall on the Pulneys was also more than the average, and was well distributed. The blossom showers were received in time and the development of the crop is good.

60. Leaf disease on the Pulneys was noticed in a severe form from August followed by considerable shedding of leaves. The position continued to be bad till the end of December. On the Nilgiris, leaf disease assumed serious proportions aided by the favourable weather conditions in the North-East Monsoon months. Though green bug was noticed in pest proportions, it was effectively kept under check by the entomogenous fungi, and the use of insecticidal sprays. The incidence of the white stem borer on arabica and shot-hole borer on robusta was negligible. The coffee berry borer was noted to a limited extent on the Pulneys and the Sirumalai.

61. A study of the performance of Station Selections showed that among the several Selections, S. 795 was popular among the planters. Plants of this Selection have yielded 2 to 2.6 cwt. per acre three years after planting. This Selection has also been found to be coming up well at the lower elevations of South Kerala.

62. He was on tour for 179 days, visited 207 estates, contacted 387 planters and addressed nine gatherings of planters. A total quantity of 1,604 lb. seeds of Station Selections was distributed to 173 planters during the year. Four applications for the sanction of grant-in-aid loans were disposed off after visits to the estates.

Pulneys Liaison District

63. Sri. K. C. Ananth was in charge of the zone from the beginning of the year till 10-6-1958 when he was transferred to form the newly created Nilgiris Liaison District. Sri. S. J. Mathias joined duty on 11-6-1958 and continued

to be in charge of the zone till the end of the year under report. Sri. P. K. Ramachandran, Liaison Assistant, continued to be in charge of the post for the entire period except for a short period of 37 days when he was away on earned leave.

64. Seasonal conditions on the whole were satisfactory in most of the ranges. The rainfall was normal and well distributed. Blossom showers were received in time followed by adequate backing showers. The crop prospects are encouraging.

65. The incidence of leaf disease in general when compared with the previous year was severe. Considerable crop loss was reported from estates which did not either receive timely plant protection measures or intensive cultivation. *Cercospora* was negligible in the nurseries and the new clearings. The white stem borer on arabica was seen in a pest form on the Bodi and Sirumalai Hill ranges and suitable control measures were advocated. The incidence of green bug and the berry borer was at a minimum and spraying with insecticides was advocated for their control.

66. A quantity of 840 lb. seeds of Station Selections was distributed to 133 growers during the year as against 293 lb. seeds to 51 planters in the previous year. The Station Selections showed comparatively very low incidence of leaf disease and were relatively free from any of the other pests and diseases affecting coffee. These did not differ from the local material in their response to blossom showers.

67. The demonstration, re-orientation and differential manurial blocks numbering 24 started previously were continued. The yields from these plots have shown a steady increase and has attracted the attention of a number of growers in the neighbourhood and encouraged them to adopt improved cultivation practices. The four exploratory-cum-varietal trial plots to study the performance of Station Selections were continued.

68. He was on tour for 201 days, visited 153 estates, contacted 286 planters and addressed 28 gatherings of growers. Thirty-nine demonstrations of improved plantation practices were conducted. Advisory correspondence totalling 123 were attended to. Twenty-eight applications for the sanction of grant-in-aid loans were disposed off after inspection of the estates. Calendar of operations were issued to seven estates which received loans under the Development Plan and follow up visits were made to watch the progress.

Nilgiris Liaison District

69. Consequent on the creation of a new Liaison District comprising the North-East and South-West Monsoon zones of the Nilgiris revenue district (including Nilgiri-Wynaad), Sri. K. C. Ananth was placed in charge of the district with effect from 16-4-1958. His headquarters was fixed at Coimbatore pending arrangements for opening of the office at Coonoor.

70. The rainfall for the year was well distributed and generally above average. The months of October and November recorded the maximum precipitation characteristic of North-East Monsoon areas. The favourable weather conditions resulted in a severe incidence of leaf disease and considerable defoliation was

noticed in unsprayed holdings. The damage due to green bug, on the other hand, was negligible due to natural enemies, and parasitic fungii keeping it under check. The incidence of red borer and cercospora was at a minimum.

71. Ten demonstration plots, five re-orientation blocks, and four differential manurial blocks were in operation in different estates in the zone. The field manurial trial at Maruvahalla and varietal trials in Maruvahalla, Crofton and Glenburn were continued. The borer control experiment at Glenburn was in progress.

72. He was on tour for 59 days, visited 80 estates, contacted 164 planters and addressed three gatherings of growers. The number of advisory correspondence handled was 70. Four applications for the sanction of grant-in-aid loans was disposed off after inspection of the concerned estates. One hundred and seventy-five pounds seeds of Station Selections were distributed to 19 planters during the year.

Shevaroy's Liaison District

73. Sri. L. V. Vaidyanathan held charge of the zone during the period under report except from 11-12-1957 to 24-4-1958 when he was on special duty for work connected with quality control. During this period Sri. K. Haridas Menon, Liaison Assistant, was in charge of the current duties of the post.

74. Seasonal conditions were fairly satisfactory. The rainfall received during the year was below average. However, timely blossom showers followed by adequate backing showers helped in the set of a good crop. The crop for the 1957-58 season amounted to 2,240 tons and the crop prospects for 1958-59 season are placed at 1,800 tons.

75. The very favourable weather conditions aggravated the infection of leaf disease and, leaf shed and die-back in a severe form was noticed. However, timely spraying operations were taken up on a concerted scale and over 80 per cent. of the area in the zone was covered. Other minor maladies like cercospora, collar rot, root and stump rot were either absent or their incidence was negligible. The incidence of green bug and white stem borer was negligible and kept under check by timely mechanical and plant protection operations.

76. A total quantity of 306 lb. seeds of Station Selections was distributed to 52 growers during the year as against 428 lb. to 57 planters in the previous year. Among the several selections, S. 795 is in great demand. Most of the plantings are very young and in their initial years of cropping.

77. Twenty demonstration plots, five re-orientation blocks and six differential manurial trial plots opened previously were continued during the year. The field manurial trial at Vasambady, the two varietal trials at Carmel and Cauvery Peak and five plant protection trials against borer and leaf disease were continued.

78. He was on tour for 168 days, visited over 100 estates, contacted an equal number of planters and addressed ten gatherings. Advisory correspondence

totalling 300 on matters pertaining to plant protection, manuring, shade regulation etc., was issued. Three applications for the sanction of loans under the Development Plan were disposed off and calendar of operations issued to four that received loan aids.

Senior Liaison Officer (Development), Balehonnur

79. Sri. W. Raghavendra Rao, Senior Liaison Officer continued to be in charge of the post during the period under report except for a period of 25 days when he was away on earned leave. Sri. K. Haridas Menon, Liaison Assistant, was transferred to Yercaud on 5-12-1957 and the post remained vacant for the rest of the year.

80. He was on tour for 40 days in the several liaison areas to study the performance of Station Selections, survey the incidence of red borer in Mudigere, assess the probable causes for uneven development of berries in parts of Saklespur and North Coorg and to visit regional seed plots for supervising the preparation of seed coffee and its distribution. He assisted the Director in the implementation of the several schemes under the Development Plan.

Koppa Liaison District

81. The District of Mudigere was bifurcated during the middle of April, 1958, and all estates situated in the Koppa-Sangameswarpet-Magundi section were constituted into a new Liaison District. This district was placed in charge of the Senior Liaison Officer (Development) with headquarters at Balehonnur. The area under coffee is about 15,900 acres of which 10,000 acres are under robusta.

82. Seasonal conditions during the year were normal. Blossom showers were received during the last week of March followed by timely and adequate backing showers. The crop prospects for the 1958-59 year are encouraging. The incidence of leaf disease and black rot was at the minimum. The damage due to white stem borer on arabica was low while that due to shot-hole borer on robusta has been on the increase. Suitable control measures were advocated. The red borer was seen attacking young clearings.

83. The chief problem of the zone is the low and stagnant yields of robusta ranging from 2 to 4 cwt. per acre. A reorientation programme based on shade regulation, spacing of plants, pruning, soil cultivation and manuring, has been taken up and six reorientation plots extending over an area of 150 acres have been laid.

84. He was on tour for 25 days, visited 50 estates and met an equal number of planters. Eighteen demonstrations on improved plantation practices were conducted and 24 gatherings of planters were addressed. Three problem areas were visited and necessary advice rendered.

B. T. NARAYANAN,
Director of Research.

PART IV

A. SUMMARY OF RESEARCH

I. AGRONOMY

Trials started earlier on the influence of different cultural practices on the yield of coffee, manuring of robusta with and without pruning and the effect on the growth and yield of young arabica coffee by mulching, and growing green manure and cover crops were continued. Studies on the estimation of the crop, germination studies on arabica coffee seeds and the growing of coffee by the Brazilian system were pursued. Trials with growth-promoting substances were newly initiated to study their effect on growth and bearing of arabica coffee.

2. The experiments on the influence of renovation pitting, trenching, weeding, and deep and light digging in different seasons of the year were continued at Balehonnur and Chethalli. The results during the year were not significant but a study of the mean average yields for the past three years showed that trenching was superior to renovation pitting or deep digging. Light digging accounted for poor yields.

3. The trial to study the effect of deep and light digging in three seasons of the year, viz., early summer, mid-monsoon and late autumn started in the year 1954, was continued. Observations during the year showed that there were no significant differences between the treatments and the different seasons of operation. However, a study of the mean average yields for the past three years showed that light digging in August or November gave the maximum yields.

4. Three experiments on manuring of robusta coffee with and without pruning are in the sixth year of study and no significant differences in yields have yet been obtained. The trends in respect of cumulative yields, however, showed that application of 40 lb. nitrogen with or without pruning is likely to be economical in the long run.

5. In the trials started last year to find out the effect on growth and yield of young arabica coffee by mulching and growing of green manure and cover crops, initial growth measurements and yields were recorded.

6. The blossom-berry studies of last year were extended to devise a more accurate and practical method of estimating the crop than the erstwhile system of eye estimate on the blossom. In pilot studies at the two Stations based on monthly counts of berries from randomly selected branches, trees and blocks of the estates, it was seen that the estimates were generally on the high side by two to three times, when compared to the normal method of estimating the crop on the blossom. Concurrently with the above, crop estimation studies by the complete stripping of randomly selected plants from different blocks of the estate well ahead of the

harvest date, gave estimates in close conformity with the actual yields registered by the blocks.

7. Germination studies during the year showed that addition of compost manure generally accounted for maximum percentage of germination. The kind of materials used for mulching or the different frequencies of watering of nursery beds did not materially affect the germination provided the beds were well prepared with adequate drainage facilities.

8. The observational trial to study the Brazilian method of planting four seedlings in pits, spaced widely apart and with suitable modifications to suit our condition, was continued.

9. The trial to find out the optimum type and combination of shade trees for arabica coffee started in 1955 at the Sub-Station, Chethalli, with 10 shade trees, was continued.

10. Different concentrations of the potassium salt of gibberellic acid had an inhibitory effect on the germination of arabica coffee seeds. While treatment of cuttings in different concentrations of the solution for 24 hours did not aid rooting, treatment of single noded sucker cuttings in 10 p.p.m. of the solution for three minutes gave maximum percentage of rooting in respect of the first and second nodes. A study of the growth characteristics of seedlings treated with Gibberellic acid showed that growth differences were not significant by the soil application method; on the other hand, application of the chemical as a spray on the foliage resulted in three to four-fold increases in height of seedlings, longer internodes and increased weight of shoot and root portions. Concentrations of the chemical at 50 and 100 p.p.m. gave the best results while weaker concentrations had apparently no effect.

II. BOTANY

11. Work on coffee breeding with reference to leaf disease resistance and high and even bearing qualities was continued. Selfing and hybridisation of selected plants, raising their progenies for performance tests, vegetative propagation of promising bearers, comparative trials of clonal progenies raised from promising materials and collection and establishment of plant material of local and foreign origin as foundation stock were in progress. Cytogenetical studies on interspecific hybrids of coffee were continued.

12. Pure line breeding to isolate selections resistant to leaf disease and with high and even bearing qualities was continued in respect of the 3rd, 4th and 5th generation progeny of S. 26; 3rd generation progeny of S. 31, S. 44, S. 72, S. 73, S. 178 and S. 179; and 2nd and 3rd generation progeny of S. 795. A high degree of resistance to leaf disease was noticed in the third generation progeny of S. 795. Cross-breeding of S. 795 and the first generation of S. 178 with one Ethiopian and three Guatemalan selections were done.

13. Out of 63 crosses between arabica cultures established since 1952, 18 cultures showed resistance to leaf disease while in as many as 40, the extent of

infection ranged from 1.1 to 39 per cent. Five crosses showing over 50 per cent. infection have been discarded.

14. Progeny trials to isolate best performers out of seedling and clonal progenies of arabica and robusta cultures were continued. The former continued to show freedom from leaf disease. It is too early to assess their performance as they are only in the initial years of bearing.

15. In the trials laid out to study the back cross of hybrids (Robusta $\times$ Arabica), evolved as well as naturally occurring (Devamachi), with Kents arabica showed that as high as 41 per cent. of the back crosses were susceptible to leaf disease while up to 17 per cent. of the plants were sterile. The disease free, fertile plants, on the other hand, indicated possibilities of heavy yielding tendencies. In the back cross with robusta, the progeny was found to be free from leaf disease, characterised by good yields, and high percentage of peaberry but with morphological characters of the robusta parent. The cytological work on these interspecific hybrids was intensified. The nature of valency of chromosomes as well as the analysis of pollen grains were under way.

16. The studies to root single noded leafy sucker cuttings of arabica with the aid of two proprietary products, viz., Seradix L. 15 and L. 30 and cow's urine extract were continued. The treatment with Seradix L. 15 gave 71.1 per cent. rooting while Seradix L. 30 and cow's urine extract gave 61 and 62 per cent. respectively. Top-working trials with 2 to 3 months old arabica scions on robusta stocks using the technique of wedge grafting has been consistently giving over 80 per cent. success. This offers an easy method of converting robusta plants and small crops from the latter can be obtained during the periods of conversion till such time as the arabica scions start cropping.

17. The exchange of seed material between several coffee growing areas in the world and this Station was continued. The progress of the introductions totalling 121 of arabica, 4 of liberica, 10 of robusta, 2 of excelsa, and 6 other species of coffee continued to be satisfactory. While all the varieties of arabica were showing susceptibility to leaf disease to varying extent, three selections from Ethiopia and one from Tanganyika showed freedom from infection.

18. Experiments laid out to compare the performance of both arabica and robusta trained by the multiple stem system as against the common practice of growing coffee on single stems, showed that practically no differences in yields were noticeable between the trees trained by either system over a period of eight years. Though the pruning of the trees trained by the multiple stem method is comparatively easier, the incidence of white stem borer on arabica and shot-hole borer on robusta appears to be high.

19. In the trial to study the performance of the Station Selections at the Sub-Station, Chethalli, it was seen that S. 795 has been consistently giving high yields for the seventh year in succession and followed by S. 645 for the past three years.

III. CHEMISTRY

20. Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on growth and health factors and studies on the processing of the crop were continued.

21. In the permanent manurial trial on arabica to study the essential requirements of the three major plant foods, the yields for the 18th year were recorded. Application of nitrogen and phosphorus accounted for the highest yields, thereby confirming that application of nitrogen alone does not result in crop increase commensurate with the increase of fertiliser and that addition of phosphorus helps in the better utilization of nitrogen.

22. These fundamental experiments were extended to trials on the different forms of nitrogen, on the application of varying doses of nitrogen ranging from 40 to 100 lb. with fixed levels of potash and phosphorus, on the application of varying doses of phosphorus and potash with a fixed basic level of nitrogen, and on the application of varying levels and combination of N, P and K on specially planted plots since 1952.

23. Field trials to find out the optimum economic dose of nitrogen and the role of phosphorus and potash in the utilization of the former, the observational trials on the effect of increasing doses of manure and the effect of fertiliser mixtures containing insecticides, were continued.

24. Field manurial trials with arabica coffee started in 10 estates in different soil and climatic zones on the application of 40 to 100 lb. of nitrogen in split doses with and without phosphorus and potash brought out the importance of phosphorus in enhancing crop yields and the feasibility of applying nitrogen in two or more split doses. The trials further brought out that up to 60 lb. of nitrogen, application of 30 and 40 lb. of phosphorus and potash respectively may be adequate but at higher levels of nitrogen, increased application of the latter may become necessary.

25. Similar trials on robusta in progress in five estates gave indications that application of a complete fertilizer containing the three major plant foods is likely to lead to higher yields. The modified robusta manurial trials with due emphasis on increasing doses of phosphorus and potash relative to that of nitrogen laid in 14 estates were continued.

26. Experiments on the response to manuring of coffee seedlings in the nursery showed that provided the initial fertility of the medium was high and the drainage optimum, good growth of coffee resulted.

27. Field trials to study the effect of chelated metals and trace elements on the growth and yield of coffee newly started during last year were continued.

28. Studies on the growth and yield of coffee in relation to shade requirements and the effect of application of Duraset on flower and fruit set were continued.

29. In the studies to find out the seasonal variations on the availability of nutrients in the soils under different shade trees, it was noticed that the plant nutrients were in general more easily and in larger quantities available under *Ficus glomerata*, than under *Albizzia stipulata* and Dadaps. However, while the soils under the last two tended to be more clayey, those under jack, silver oak and *Ficus glomerata* were loamy in texture.

30. Studies on the elimination of fruity flavour of cherry coffee showed that a progressive decrease in fruity flavour was noticed as the coffee aged and that washing with water improved the quality to a little extent.

IV. ENTOMOLOGY

31. Studies on the seasonal intensity of incidence of the major pests of coffee like the stem borer, green bug and nematodes on arabica and shot-hole borer on robusta and their control by the use of chlorinated hydrocarbons and organo-phosphorus compounds, including systemics, were continued. Studies on the biological control of certain pests on coffee with their parasites were also extended.

32. In the stem borer control trials at the two Research Stations and in the Liaison Zones, it was observed that Dieldrin and B.H.C. gave satisfactory results more consistently than Heptachlor, Gusathion and Chlordane. Addition of stickers to the chemicals did not prove beneficial.

33. Trials with systemics and other organic insecticides on the control of green bug showed that Metasystox, Folidol and Gusathion effected one hundred per cent. control of the pest three weeks after application of the chemical.

34. Extended trials on the control of shot-hole borer by organic chemicals such as B.H.C., Heptachlor and Dieldrin showed that the incidence was least on plants sprayed with B.H.C. Systemic chemicals like Metasystox and Ekatin have not proved so far effective.

35. The soil amendment treatments with and without sulphur to control eelworms did not effect any significant reduction in the population of eelworms. On the other hand, application of V.C. 13 Nemacide gave indications of significant reduction in their number. Trials with Crag fungicide and Nemagon were not conclusive.

36. Studies on the bionomics and life-history of the hairy caterpillar, leaf eating caterpillar, and the green bug parasite were continued in the laboratory. The nomenclature of as many as four different eleworms affecting coffee was determined.

V. MYCOLOGY

37. Field trials on spraying of coffee to find out efficient and economic methods of control and to evaluate the efficacy of various proprietary fungicides as compared to the standard Bordeaux mixture in controlling the major diseases of coffee and fundamental work on the life-history and possibilities of control of the common diseases were continued.

38. Comparative spray trials using various proprietary fungicidal formulations based on copper, mercury, sulphur and of organic nature for control of leaf disease of coffee have shown that the half per cent. Bordeaux mixture now in common use is as good as and in some cases better than the proprietary formulations tested. Addition of detergents, wetters, spreaders, etc., to Bordeaux mixture has not given any significant and consistent improvement in efficacy of disease control.

39. Trials to determine the optimum time of spraying Bordeaux mixture in North-East Monsoon areas and the use of chemicals in controlling monsoon leaf shed started previously were continued.

40. An initial sterilization with Bordeaux mixture or formaldehyde followed by routine drenching of the soil with Bordeaux mixture at fortnightly intervals was found to effect a good control of damping off and collar rot disease. Investigations on possibilities of biological control of this disease using different micro-organisms have been initiated.

41. Studies on the brown eye spot disease showed that the disease was not selective in respect of the different arabica types and that application of one per cent. Bordeaux mixture, Flit 406, 0.4 per cent. and Dithane 0.4 per cent. gave fair control of the disease. Application of urea, on the other hand, did not reduce the disease incidence.

42. In the special project to investigate the various nursery and post-nursery diseases affecting coffee, information on the incidence, intensity and periodicity of different types of maladies have been collected. Control of the above by chemicals and phyto-sanitary measures was under way.

VI. GENERAL

Field Performance of Station Selections

43. The co-ordinated project on a critical study of the field performance of Station Selections, in particular of S. 288 and S. 795 in wide circulation, was continued during the year under report.

44. Sixty estates spread over the 12 Liaison Districts of coffee in South India were selected for this purpose. The study in particular refers to the following five factors, viz. (i) growth characteristics including the incidence of pests and diseases in the nursery and post-nursery stages, (ii) response to blossom showers, (iii) yield performance, (iv) out-turn in grade percentages of the curers product, and (v) quality of the final produce (raw, roast and liquor qualities).

(i) Growth Characteristics and Incidence of Pests and Diseases

45. The earlier impressions that the Station Selections once they were established were vigorous and showed a remarkable resilience to attacks by pests and diseases were confirmed. There was, however, one disturbing factor which was noticed during the enquiry. In the case of the younger plants, considerable distress

in the dry period following the monsoons often leading to severe leaf shed was noticed, especially in areas where indifferent shade and exposed soil were the normal conditions.

46. As a contrast to this it was seen that where regulated shade—a protective canopy—was maintained during this critical period and the open ground was heavily mulched and incidentally moisture conservation was practised, the bushes continued to make good growth and showed no signs of distress.

47. The nursery and post-nursery disease noticed earlier—ring barking—was fortunately very low during the period under report even in those areas where it appeared in an alarming degree during the last season. It was also observed that this particular type of nursery and post-nursery disease was not specific to the Station Selections, but attacked the older coffees also under the same conditions of nursery and post-nursery management.

48. The attack of *cercospora* noticed on the Station Selections was equally common in the older established coffees also. The incidence of *cercospora* during the year was practically negligible in the major portions of the coffee areas and seen to be confined to a few isolated blocks of estates in North Mysore and Central Mysore coffee districts.

(ii) *Response to Blossom Showers*

49. The response to blossom showers of varying intensity has again been conflicting. In areas where the plants have been well protected against moisture distress during the dry period following the cessation of the monsoon rains, the response to small quantities of rain has been equally as good as in the case of older varieties in common growth on the estates.

50. In areas where they were being grown in the open with possibly heavy foliage and where the land had been allowed to dry and was in a parched condition, there has been a distinct demand for an appreciable quantity of rain of over 80 cents on the average. There was however one encouraging factor observed in such cases. Smaller showers than 40 to 50 cents helped to move and develop the bud and incidentally initiated a second set of bud growth. The buds developed earlier stayed quiescent without any damage. Later showers helped to bring forth a high percentage of blossom. It would appear again that the resilience noticed in these Selections against adverse conditions of cultural practices seemed to be effective even under adverse conditions of moisture supply. Observations are being continued.

(iii) *Yield Performance*

51. From the figures available with the plantations selected for this study, yield levels have varied from an average of 5 to 6 cwt. of primary crop in the case of well maintained blocks to as high as 10 to 12 cwt. from the 7th year onwards. There have been record yields of 17 cwt. to the acre in 22 per cent. of the selected estates.

(iv) *Out-turn in Grade Percentage of the Cured Product*

52. It was noticed during the enquiry that the Station Selections have a tendency to have a higher triage than the established coffees, in certain particular situations and conditions of growing. The triage returns have varied from a low 10 per cent. to as high as 20 to 30 per cent. It would appear from the preliminary observations and return from Curing Houses that these high triages have invariably been associated with high crops bordering on over-bearing and the lower triages with an optimum sizable crop for the plant at its age. Detailed investigations have been taken up to devise means to control this tendency and keep the bush in an even level of bearing.

53. As a corollary to the work now on hand, a special project to define and fix the characteristics of the parent material and thus enable a selection of future parents in the plant breeding work has been set up. A detailed study of the behaviour of the fruit from the spike initiation stage to the fully developed and mature fruit has also been undertaken.

(v) *Quality of the Final Produce*

54. The project for studying the market reactions abroad of the newer varieties of coffee as compared to the older established coffees inclusive of Kents, Coorgs and others started during the last year was extended under the Quality Scheme to a comparative test of the Station Selections with Kents and the older established coffees.

55. Market reactions in respect of the 5-ton samples of A grades of S. 288 and S. 795 sent to London in the last year revealed that these were in no way inferior to comparable superior classified coffees from British East Africa considering the prices obtained at the time of sale in London and in spite of the time lag between curing and marketing.

56. Concurrently 18 samples of these two Station Selections and estate bulks were sent to Kenya and eight samples each to London, New York and Hamburg for exploratory quality tests in the testing houses. No differences among the varieties were reported so far as quality was concerned.

57. During the year under report blind samples of the three grades A, B and CT of the two Station Selections, Kents and the older varieties of coffee were drawn from six estates selected at random in the States of Mysore, Madras and Kerala and sent to the five testing centres in London, Hamburg, Amsterdam, New York and Switzerland for summative quality tests.

58. The reports from these centres indicate that the Station Selections in general are not inferior to the older coffees—Kents, Coorgs, etc.—under the same conditions of soil, climate and zone and subjected to the same preparatory processes both at the estate and the curing levels. In general, the samples, irrespective of the variety, are at least of the F.A.Q. standard required of established coffees. Any fall in quality seems to be more for want of careful attention in processing

at the estate and curing levels than on account of any inherent characteristic of the bean of these several varieties.

59. In the light of this emphasis on processing, an extended trial was undertaken on the study of the various stages of processing at the estate level. Investigation was confined to the wet processed or parchment coffee. The fruits were subjected to 14 treatments involving selection and grading of the unpulped fruit, pre- and post-washing grading of the parchment and quick and slow drying of the resultant parchment. Details of this trial are furnished in Appendices No. A and B.

60. The parchment samples so obtained under different treatments of each of the varieties were graded after hulling and eight ounce lots of the three grades A, B and CT have been sent to the afore-mentioned five testing centres in Western Europe, London, U.S.A. and Nairobi (Kenya). The following list summarises the number of such samples sent to each of these testing centres. Reports from these testing centres are awaited.

			Grade A	Grade B	Grade CT	Total
London	..	..	154	80	136	370
Hamburg	..	..	152	99	147	398
New York	..	..	47	2	1	50
Switzerland	..	..	152	50	129	331
Nairobi	..	..	153	50	144	347

61. The Research Department of the Coffee Board has accepted the offer of the Indian Council of Agricultural Research, New Delhi, regarding the setting up of a "Soil Testing Laboratory" at the Coffee Research Station, Balehonnur, under the scheme for expanded soil testing service of the United States of America Technical Co-operation Programme and the Government of India. The scheme commenced functioning from 16th June, 1958, with the reporting for duty of the Assistant Soil Chemist. Preliminaries like setting up of the laboratory, posting of the necessary complement of staff, etc., were taken up.

62. The work of the soil testing centre will in the first instance be to undertake the analysis of a large number of soil samples from planters' estates and correlate it with the previous crop and normal plantation practices. Based on the studies, the centre would render necessary advice in the laying out of fertilizer demonstration trials as well as application of suitable manures to the coffee.

63. The project to investigate nursery and post-nursery diseases affecting young coffee in certain areas, especially South-West Mysore, started last year was continued. A preliminary survey of such areas with particular reference to inci-

dence and intensity was undertaken. The work will be extended to study the application of suitable plant protection measures for controlling the same.

64. The special project for testing of proprietary pesticides and fungicides on a field scale in the various coffee zones was initiated towards the close of the year. This would enable their subjection to comprehensive and extensive tests both in the laboratory and in the field by specially trained staff, before they are recommended for the control of pests and diseases affecting coffee. The tests will normally be carried over a period of three years and the results will be published as and when they are available for release.

65. A pilot scheme to investigate the possibilities of sprinkler irrigation on coffee has been taken up. The experiments have been designed to study the influence of intensity and number of applications over a period of five months extending from November to March, applications being made at monthly intervals. The comparative economics of night and day irrigation will also be examined with a view to minimise loss in application and thus obtain greater effective use of available water. Concurrently studies on the fertilizer, light intensity and shade requirements are also proposed.

B. T. NARAYANAN,
Director of Research.

B. DETAILED SECTION REPORTS

I. AGRONOMY

The main work of the Agronomy Section consisted of studies on the influence of several cultural and soil management practices on the yield of coffee, manurial trials with and without pruning on robusta coffee, and the effects on growth and yield of young arabica coffee by mulching and growing green manure and cover crops. Studies on the estimation of the crop, germination of arabica coffee seeds and growing of coffee by the Brazilian system with suitable modifications were pursued. Trials with growth promoting substances were newly initiated during the year to study their effect on growth and bearing of coffee.

Field Experiments

I. Studies on the Influence of Varying Soil Cultivation Practices on the Yield of Arabica Coffee

(a) *Soil Cultivation Experiment—Coffee Research Station, Balehonnur.*—This trial started in July, 1954 on old arabica coffee was continued. Different methods of soil cultivation such as trenching, renovation pitting and light and deep digging are compared against control which is given weeding only. During the year, the season for trenching and renovation pitting was advanced to May instead of July so that the operations could be carried out prior to the commencement of the monsoon. The yield data of the experiment are given in Appendix X.

The yield differences during the three years the trial has been in progress are not significant. Trenching $1\frac{1}{2}$ feet deep in the first year, renovation pitting in the second year and trenching $\frac{3}{4}$ foot deep in the third year gave numerically highest yields. Light digging in general accounted for the lowest yields. A study of the mean average yields for the past three years showed that trenching was numerically superior to renovation pitting or digging but there were no differences between the two depths of trenching. Light digging was found to be equal to control, which received weeding only. The yields in the case of clean coffee also showed a similar trend.

The experiment is being continued.

(b) *Soil Management Experiment—Coffee Research Station, Balehonnur.*—This experiment was started in July, 1954 with the object of studying the effects of digging to two different depths in three seasons of the year on the yield of coffee. The experiment is laid on old arabica coffee planted at a spacing of 5 feet and received all other operations in common except the treatments. The yields of coffee, both cherry and clean, for the past three years are presented in Appendix XI.

The treatment differences during the three years the trial has been in progress are not significant. Light digging in November in the first year, weeding only in the second year and deep digging in November in the third year accounted for the highest yields. A study of the mean average yields for the past three years showed that light digging in August was the best, thereby indicating that weeds in general compete with the coffee bushes at a time when the development of the bean is at its maximum.

The experiment is being continued.

II. Manurial Experiment on Robusta—Coffee Research Station, Balehonnur

The manurial trial was laid out in the year 1951 with a view to study the effect on yields of varying levels of nitrogen with fixed applications of phosphorus and potash. The robusta trees in the plot are planted at a spacing of 8 feet $\times$ 8 feet and are about 25 years old. Half the dose of nitrogen is applied during the pre-blossom and the other half, along with the full quantity of phosphoric acid and potash, is applied in the post-monsoon period. The two levels of nitrogen under study are 40 and 80 lb. to an acre while the rates of phosphoric acid and potash are 30 and 40 lb. respectively.

The yield data of the experiment are furnished in Appendix XII. The results during the year are not significant. The yields for the six years the trial has been in progress, have not also yielded any significant results. During the year 1957–58 plots receiving 80 lb. nitrogen gave the highest numerical yield followed by those receiving no manure.

The experiment is being continued.

III. Robusta Manurial and Pruning Experiments—Private Estates

Two experiments were laid out during 1952 in private estates, *viz.*, at Badra and Devadhanam, on the same lines as in the robusta manurial trial at the Coffee Research Station, Balehonnur. These experiments were further extended to study the influence of light pruning on the yields of coffee. The coffee bushes are of medium age and are planted at a spacing of 8 feet $\times$ 8 feet.

The two levels of nitrogen, *viz.*, 40 and 80 lb. to an acre are applied in two split doses during pre-blossom and post-monsoon seasons. The fixed levels of phosphoric acid and potash at 30 and 40 lb. to the acre respectively are applied during the post-monsoon season. Pruning of the bushes is done in the pre-blossom period.

(a) The yield data of the experiment at Badra Estate are given in Appendix XIII. The yield data during the year are not significant as also the results for the past four years. However, for the second year in succession plots receiving no manure but pruning only, registered the maximum numerical yields.

(b) The yield data of the trial at Devadhanam Estate are furnished in Appendix XIV. The yield differences during the year are not significant as also the yields for the past four years. However, for the third year in succession plots receiving 40 lb. nitrogen in combination with pruning, gave the maximum numerical yields.

From the above manurial trials conducted at the Coffee Research Station, Balehonnur, and in two private estates over a number of years, it may be concluded that application of 40 lb. of nitrogen, with or without pruning, is likely to result in the better cropping of the robusta bushes.

The experiments are being continued.

IV. Experiment on the Influence of Topping on Growth and Yield of Robusta Coffee—Byregudda Estate, Balehonnur

This experiment was laid out at Byregudda Estate, Balehonnur, in the year 1951 to study the effect of topping robusta plants at 3 and 4 feet heights respectively. The plants at the time of the treatment were three years old.

Growth increments recorded in the first four years of the trial, as reported in last year's report, showed that though in the initial years plants topped at 3 feet heights registered better growth, later on they tended to become level with the plants topped at the higher level of 4 feet.

The stem girth measurements and yield data are presented in Appendix XV.

The yield differences during the year are not significant. However, plants topped at 4 feet height registered numerically higher yields for the third year in succession.

In respect of stem girth, though the results are not significant, for the first time plants topped at the higher level led those topped at the lower level.

The experiment is being continued.

V. Mulching Trials on Young Arabica Coffee

Two trials started during the year 1957 to find out the effect on growth and yield of young arabica coffee by mulching, growing green manure and cover crops were continued. The trials were laid in clearings planted with arabica selections during the year 1954 in the L₂ Block of the Coffee Research Station, Balehonnur.

(a) *Mulching experiment*—Coffee Research Station, Balehonnur.—The green manure and cover crops used in the trial are *Crotalaria anagyroides* and *Calapogonium mucunoides* respectively. The green manure crop was cut periodically to a height of about 18 inches whenever it was in flowers.

The coffee plants in the experimental area being young, were not allowed to bear any crop during the year 1956–57 while during the year 1957–58, the buds on the brown wood alone were allowed to mature a crop. The yield data and growth measurements are furnished in Appendix XVI.

The basic yields recorded during the year are not significant. In respect of stem girth measurements also, no significant differences were noticed but plants receiving treatment 'E' registered the maximum increase over previous year's girth.

(b) *Mulch cum manurial experiment*—Coffee Research Station, Balehonnur.—The two types of mulches were applied in December, 1957. The manures were applied in two doses, one pre-blossom and again in post-monsoon.

The coffee plants in the experimental area being young, were not allowed to bear any crop during the year 1956–57, while during the year 1957–58 the buds on the brown wood alone were allowed to mature a crop. The yield data and growth measurements are furnished in Appendix XVII.

The basic yields recorded during the year are not significant. In respect of stem girth measurements also, no significant differences were noticed during the year or in the mean annual increment. However, it was seen in respect of the latter that mulching with dry leaves accounted for increased stem girth of the plants over the control, while the effect of manures was not very much in evidence.

VI. Studies on Crop Estimation

(a) The pilot study is intended to devise a more accurate method of estimating the crop than the erstwhile system of 'eye' estimates on the blossom. At both the Coffee Research Station, Balehonnur, and the Coffee Research Sub-Station, Chethalli, five blocks were chosen at random, and from each block five trees. The number of bearing branches in each selected tree was counted and five representative branches representing top, middle and bottom portions were utilised for counting the number of spikes/blossom/berries as the case may be at monthly intervals. From these, the yields per tree/block/acre and then for the estate were estimated after adjusting the yields with suitable correction factors.

The estimates of crop based on the above studies as well as by the usual method are furnished below:—

Crop Estimation Studies, 1957-58

Place where study conducted and crop variety	Estimate of crop in tons during 1957-58								Estimate on blossom	Actual yield	
	Feb. Spike	May Blos.	June	July	Aug.	Sept.	Oct.	Nov.			
<i>C.R.S., Balehonnur</i>											
1. Arabica ..	45.23	34.27	32.83	46.87	37.52	40.00	41.23	40.33	13.00	17.09	
2. Robusta	41.35	33.86	18.00	16.44	13.01	12.41	16.40	16.34	7.00	9.69	
<i>C.R.S.S., Chethalli</i>											
3. Arabica ..	30.14	36.10	43.21	68.40	72.72	63.40	..	..	46.00	34.13	

From the above studies it is seen that the estimates of crop by the new method is on the high side when compared to the normal method of estimating the crop on the blossom. The steep rise in the case of robusta in the last two months is due to high correction factors employed. The blossom estimates also in general were lower than the actual, due perhaps to successive flowerings in coffee occasioned by the receipt of intermittent showers received after the main incipient blossom showers.

(b) Concurrently with the above, crop estimation studies by the complete stripping method were also undertaken during the year. The technique, in brief, consists in the stripping of randomly selected plants from different blocks in the estate and calculating the yield of coffee for the block and then the estate, after making due allowance for non-bearing and young bushes. The harvests were made in September, October and November on three sets of plants to find out the optimum period for the above studies. Nine blocks were chosen at the Coffee Research Station and in each block four plants were selected at one per quarter. The green fruits were harvested from the selected bushes in the above months, and the yields arrived at after making allowances for green fruits. The clean coffee yield was estimated at one-sixth of ripe cherries.

The estimates of crop based on the complete stripping method are furnished below:—

Crop Estimation Studies (Stripping Method)—Coffee Research Station

Crop	Year 1956-57				Year 1957-58			Actual	
	Blossom Estimate	Estimate by the method	Actual	Blossom Estimate	Estimates by the method				
					Sept.	Oct.	Nov.		
Arabica	..	17.00	16.60	14.25	13.00	18.21	17.68	17.03	17.09

It may be seen from the above that the yield figures obtained by the complete stripping method are in close conformity with the yield figures obtained during the year. However, further observations are necessary and in the coming year it is proposed to extend the studies to private estates in the several liaison zones.

VII. Studies on the Germination of Coffee Seeds

Experiments to determine the optimum composition of seedbeds, the effect of different kinds of mulches and frequencies of watering on the germination of seeds were under study at the Coffee Research Station, Balehonnur. The results of germination experiments being in the nature of discrete variables, analyses of variance were made with transformed data. The transformed values alone have been presented in respect of these trials.

(a) *Composition of nursery beds.*—Bulk seeds of arabica prepared in usual manner were sown in seedbeds prepared with ordinary soil, jungle soil and sand, alone or in different proportions. The design was a randomised replicated one with six treatments and four replications. Seeds were sown on 4th and 8th February, 1958. The number of seeds sown per plot was 50. The results of the experiments are presented in Appendix XVIII.

It is seen that the differences in germination percentages in respect of both the trials are not significant.

(b) *Methods of covering seedbeds.*—Seeds of arabica prepared in the usual manner were sown in nursery beds, and covered with different kinds of mulching materials to study the effects of these on the germination of seeds. Seeds were sown on 4th February, 1958. The number of seeds sown per treatment was 30. There were five treatments and six replications. The results of the experiment are furnished below:—

Germination Experiment—Method of Covering Seed Beds

Treatment				Mean percentage of germination (Average of six replications)
A.	No covering	..	..	67.7
B.	Beds covered with	gunny	..	73.5
C.	do.	paddy straw	..	66.2
D.	do.	paddy husk	..	67.3
E.	do.	dry leaves	..	64.0
General Mean				67.7
S.E.M.				2.39
Significance				Nil

The results are not significant. The ordinary method of covering the seed-beds with paddy straw appears to be as good as any of the methods tried.

(c) *Study of the determination of optimum frequency of watering.*—Bulk seeds of arabica prepared under similar conditions as in the estate were sown on 5th February, 1958 to study the effect on health and stand of the seedlings due to different frequencies of watering. There were four treatments and six replications. The number of seeds sown per treatment was 30. The results of the experiment are furnished below:—

Germination Experiment—Frequency of Watering

Treatment				Mean percentage of germination (Average of six replications)
A.	Watering daily once	..	..	71·8
B.	Watering daily twice	..	..	68·5
C.	Watering once in alternate days	..	..	70·3
D.	Watering twice on alternate days	..	..	68·3
	General Mean	..	..	69·7
	S.E.M.	..	..	1·93
	Significance	..	..	Nil

It is seen that in well-prepared beds provided with adequate drainage facilities, no differences in germination were noticed in the different frequencies of watering. The seedlings under all the treatments were healthy and free from 'damping off' disease.

(d) *Methods of drying of seed coffee.*—The experiment started last year to study the effect of drying seed coffee in the shade (normal estate practice), as against drying in the sun, was continued. Seeds of arabica coffee dried by the above two methods to a constant moisture level were sown at monthly intervals to find out the effects on germination due to the above treatments as well as that of storing seeds. The trial was laid out in a randomised replicated method with four replications. The number of seeds sown per treatment was 25. The results are presented in Appendix XIX.

It may be seen from the results that unlike last year seeds dried in the sun generally gave better germination and that seeds with parchment cover intact stored well for a longer time.

VIII. Trials with Growth-Promoting Substances and Other Proprietary Products

(a) *Gibberellic acid*.—Gibberellic acid, a plant growth-promoting substance, has shown a wide range of growth stimulation and acceleration in many types of plants ranging from ornamentals, flowers, food and forest plants. Specific results such as stem elongation and growth increase, breaking of dormancy, induction of flowering, increasing fruit setting and prevention of growth retardation at transplanting have been attributed to this chemical. Three observational trials started last year to test the efficacy of the chemical were continued. The results of the experiments are given below:—

(i) Seeds of arabica coffee were treated with different concentrations of the chemical: 10, 25, 50 and 100 p.p.m. by soaking the seeds in the solution overnight for 24 hours. Fifty seeds were used per treatment in one trial and thirty seeds in another. The layout adopted was randomised replicated design with four replications. Seeds were sown on 26-6-1957 and 10-2-1958. The results are furnished in Appendix XX.

The generally poor germination in respect of the first sowing was due to the fact that the seeds had been in storage for nearly six months. It was seen that in respect of the first sowing, gibberellic acid had generally a depressing effect on the germination of seeds, the higher the concentration the greater the reduction in germination, while with the second set, no significant differences were noticed.

(ii) Single noded leafy cuttings from the first, second, third and fourth nodes of shoots of coffee were treated by dipping the cut ends in 10, 25 and 50 p.p.m. of the substance for 24 hours. These cuttings with controls were planted in the propagation chamber on 27-6-1957. Twenty cuttings per treatment were used. Humidity was maintained by frequent watering and regulation of the windolite frame and provision of overhead thick white cloth. The rooting medium consisted of well-washed, coarse river sand. Side by side with the above, cuttings were treated with 10, 50 and 100 p.p.m. of the substance for three minutes (Quick Dip method) and planted for rooting. The results are furnished in Appendix XXI A and B.

In respect of the treatment of cuttings for 24 hours with the gibberellic acid it is seen that the maximum rooting percentage did not exceed 15. The average number of main roots produced was less than 1.7 while the mean length of roots varied from 3.4 to 11.7 cm. No rooting was noticed in respect of the other treatments.

In respect of the "Quick Dip" method, however, the trials brought out interesting results. The trials brought out clearly the superiority of tender sucker cuttings in the rooting of coffee, thereby confirming the previous work done at the Coffee Research Station. Treatment with 10 p.p.m. of the growth substance gave the maximum percentage of rooting in respect of the second and first nodes. There was a decrease in the percentage of rooting as the concentration of the chemical increased. Treatment with 50 p.p.m. of the substance with the third and fourth nodes, on the other hand, gave maximum rooting due perhaps to the

hardy nature of the tissue concerned. The highest concentration of the chemical irrespective of the sucker treated, gave the poorest response. There appeared to be no striking differences in the number and length of roots produced among the several treatments.

(iii) Seedlings of arabica coffee having three pairs of leaves and selected for uniformity were transplanted into baskets on 6-7-1957. The treatments applied were 10, 50 and 100 p.p.m. of the gibberellic acid against the untreated control. Using a hand-atomiser, the soil in the baskets around the seedlings was uniformly drenched. In another set, the foliage was sprayed so that the apical as well as lateral buds and both the upper and lower surfaces of leaves were completely covered. Two applications were done, the first on 17-7-1957, ten days after transplanting and the second on 5-8-1957, eighteen days later. Observations on height, internode length and weight of shoot and root portions were recorded on 17-9-1957 and given in Appendix XXII A and B.

A study of the growth characteristics of the plants treated with gibberellic acid showed that the effect of the chemical was noticeable for a period of three weeks only after application. No significant differences in growth were noticed during the first period, viz., between 17th July to 5th August in both the methods of application. During the latter period from 6th August to 17th September, growth differences were not significant in the soil application method, though higher concentrations of gibberellic acid gave better growth. On the other hand, during the same period, application of the chemical as a spray on the foliage resulted in significant differences in growth. Application of 100 p.p.m. and 50 p.p.m. of the substance resulted in three to four-fold increases in growth over the control. Weaker concentrations of the chemical apparently had no effect on growth.

In respect of the internodal length, no striking and significant differences in respect of the third and fourth internodal lengths of seedlings treated by the first method (soil application) were obtained. On the other hand, application of the chemical as spray resulted in very significant increase in length of the third internode in respect of the higher concentrations of the chemical. In view of the fact that the growth of this internode was prolonged, the emergence of next pair of leaves was consequently delayed. At the time of measurement, i.e., on 17-9-1957, the fifth pair of leaves of seedlings treated with 10 p.p.m. of gibberellic acid had not appeared, while in that of the higher concentrations, only one seedling in each had produced growth.

The seedlings were pulled out on 17-9-1957 and weight of stem and root portions determined separately. The mean weights of shoot and root of the seedlings as well as the shoot/root ratio are given in Appendix XXII B. The weight of shoots and roots of the seedlings receiving soil treatment did not show any significant differences. The shoot/root ratio was also very high when compared to the control. Seedlings receiving the spray treatment, on the other hand, while

giving significant increases in weight of shoots and roots in the case of plants treated with 100 p.p.m. of gibberellic acid, also gave a low shoot/root ratio.

(b) *Nikotia S. 271*.—This is a proprietary product of Messrs. Prithvi Trust, Bombay, claimed to have growth-promoting properties. Two concentrations of the chemical, viz., $\frac{1}{4}$ lb. and $\frac{1}{8}$ lb. in 5 gallons of water along with two concentrations of gibberellic acid, viz., 25 and 50 p.p.m. were sprayed on Kents arabica coffee plants on 25-2-1958, about a month prior to the expected date of blossom of the trees. The number of plants per treatment were six.

Periodical measurements on growth of selected branches, number of flower buds produced and carried to maturity are being done. Observations are in progress.

(c) *Napthalene acetic acid (N.A.A.)*.—Blossom-berry observations on arabica coffee during the years 1955 and 1956 showed that the extent of berry shed was great during the two months following the flowering, due perhaps to the altered weather conditions and competition between vegetative and reproductive phases of the coffee plant. The effectiveness of N.A.A. at lower concentrations in controlling fruit drop are well known. Hence three concentrations of N.A.A., viz., 5, 10, and 20 p.p.m. were sprayed on coffee plants, about three weeks after flowering, when fruit set was complete and the petals dried up and along with Bordeaux Mixture which is used for controlling leaf disease. Six trees were sprayed per each treatment along with control, which received only Bordeaux spray. Observations on selected branches of fruit set, fruit shed, etc., are in progress.

IX. Brazilian System of Planting

One acre of newly opened area at the Coffee Research Station, Balehonnur, was planted according to the Brazilian method, but retaining shade, during the year 1956. Pits of the same dimension as under our conditions were opened at a spacing of 13 feet by 8 feet. Four seedlings of S. 795 (disease resistant selection of arabica) were planted in each pit. While a majority of the pits were fully closed and the seedlings planted in the middle, 75 pits were only half-filled with soil and the seedlings planted in the hollow. It is hoped that by the latter method, adequate protection against wind and sun will be obtained. A thick stand of green manure was raised by sowing *Crotalaria striata* and the rows between coffee were heavily mulched by cutting and spreading the green manure.

The experiment is being continued.

X. Experiments at the Coffee Research Sub-Station, Chethalli

(1) *Soil cultivation experiment*.—A trial similar to the one at the main station was started in the year 1953 on mature arabica coffee at Chethalli. Different methods of soil cultivation and light and deep digging are under comparison against control, which is given weeding only. The yield data of the experiment are given in Appendix XXIII.

The yield differences for the past four years have not given any significant results. The results are conflicting from year to year. The experiment is being continued.

(2) *Studies on the shade requirement of arabica coffee*.—An experiment to find out suitable types and combinations of shade trees for optimum growth of arabica coffee was laid out in 1955–56 in a newly cleared area.

Locality ... Coffee Research Sub-Station, Chethalli (Coorg).
Treatments .. Ten—constituted by grouping nine out of the following ten shade trees for each treatment, omitting one at a time.

- | | |
|---|---|
| 1. <i>Ficus glomerata</i> (Atti) | 6. <i>Artocarpus heterophyllus</i> (Jack) |
| 2. <i>Ficus nervosa</i> (Malaigargathi) | 7. <i>Ficus</i> sp. (Elibasari) |
| 3. <i>Dalbergia latifolia</i> (Beete) | 8. <i>Albizzia lebbeck</i> (Kalbage) |
| 4. <i>Pterocarpus marsupium</i> (Honne) | 9. <i>Bischofia javanica</i> (Neeli) |
| 5. <i>Eugenia jambolana</i> (Nerale) | 10. <i>Ficus retusa</i> (Mitli). |

The treatments are:—

- | | |
|--------------------------|----------------------|
| A. Neeli omitted | F. Beete omitted |
| B. Jack omitted | G. Nerale omitted |
| C. Malaigargathi omitted | H. Honne omitted |
| D. Mitli omitted | I. Elibasari omitted |
| E. Kalbage omitted | J. Atti omitted. |

Replications .. 6.

Plot size .. $12 \times 12 = 144$ plants in a sub-plot with one shade tree in the centre of a group of $4 \times 4 = 16$ coffee plants.

Plant material .. S. 795 arabica.

Planting distance .. $6\frac{1}{2} \times 6\frac{1}{2}$ feet for coffee, 26×26 feet for shade tree.

Observations to be recorded are:—

1. Growth and development of coffee plants.
2. Yield.
3. Disease and pest incidence.

Temporary shade has been provided all over the area uniformly by planting the same number of dadap stakes in each plot. All the plots received uniformly the several cultural operations and manures.

B. S. KUPPUSWAMI,
Agronomist.

II. BOTANY

Inter- and intra-specific coffee breeding work to combine resistance to leaf disease (*Hemileia vastatrix*, B & Br.) and high yields were continued. (1) Collection and establishment of species, varieties, types and forms of coffee from outside India and from South Indian coffee estates, (2) comparative trials of clonal progeny of good bearers and seedling progeny of selections and cross-breeds for finding out the behaviour of the progeny regarding resistance to leaf disease and yields, (3) morphological and cytological studies, (4) examination of seed plots of approved selections for seed collections for supplies to growers, (5) experimental and demonstration work on vegetative propagation of coffee by grafting and rooting of sucker cuttings, and, (6) collection and establishment of shade tree species from sources in India and outside India formed the principal work of the Section.

Coffee seeds were obtained during the year by courtesy of (1) The Head, Plant Introduction Section, Horticultural Crops Research Branch, U.S. Department of Agriculture, and (2) Dr. Branquinho d'Oliveira, Estacao Agronomica Nacional, Oeiras, Portugal (through the good offices of Mr. C. A. Krug, Tropical Crops Specialist, Plant Production Branch, Agricultural Division, Food and Agricultural Organisation, United Nations, Rome).

Shade tree seeds were obtained during the year by courtesy of (1) Director, Instituto Agronomico Do Estado de Sao Paulo, Campinas, Brazil, (2) General Manager, Kannan Devan Hills Produce Co, Ltd., Munnar, Kerala, and, (3) Scientific Officer, U.P.A.S.I. Tea Experiment Station, Devarshola P.O., Nilgiris.

A. Coffee Breeding

1. Arabica

With a view to evolve disease resistant, high yielding and vigorous strains, cross-breeding of arabica coffee was continued. Ten crosses were effected during the year. They include the crossing of S. 795 and first generation progeny of S. 178 showing resistance to the common races I and II of leaf disease with (1) selected plants of S. 12 Kaffa (a collection from Ethiopia) exhibiting freedom from leaf disease in the field, (2) varieties Padang and Philippinean having vigorous growth and good bean characters, and (3) San Ramon exhibiting closely spaced nodes, bunchy-fruited and bushy growth. All the plants used for cross-breeding were selfed to raise further progeny to study their field performance.

1. Field Studies of Advanced Generations of Selections and Hybrids

In the observational trials started in 1952, the progeny of (1) three plants of S. 795, (2) one plant of S. 333, and, (3) five intra-crosses of arabica cultures of B.A. series continued to be under study. The progeny of S. 795 continued to show a low percentage, up to 3.4%, of leaf disease susceptible plants, and that of S. 333 up to 13.4%. Three out of the five intra-crosses which had remained free

from leaf disease during the previous years showed varying percentages of disease susceptibility ranging from 9.8 to 13.4%. The remaining two intra-crosses recorded 50 and 75% susceptibility.

The progeny of three plants of S. 795 yielded during the year their second crop ranging from 6.1 to 8.8 cwt. clean coffee to the acre. In the progeny of S. 333 and of the three intra-crosses, the yield ranged from 2 to 5 cwt. clean coffee to the acre.

The 1953 series of plantings consist of eleven cross-breeds and three hybrid collections from neighbouring estates. Six cross-breeds and all the hybrid collections were reported to be free from leaf disease in the previous year. During the year under report, however, only one cross-breed and one hybrid collection remained free from disease. In the five cross-breeds and two hybrid collections leaf disease susceptibility ranged from 4.5 to 35.7%. In the remaining five cross-breeds and two hybrid collections leaf disease susceptibility range which was 5 to 17% last year, increased to 12.5 to 39% in the case of four and 62% in one. This last has been discarded. The first yields recorded in these cross-breeds and hybrid collections have ranged from 0.3 to 4.6 cwt. clean coffee to the acre.

Progeny of ten intra-crosses between arabica cultures planted in 1954 continued to be under study. Three of these reported to be free from leaf disease in the previous year, continued to be so. The other seven intra-crosses have shown a low range, 1.1 to 4.4%, of susceptibility. This is considerably lower than the range of 2.7 to 12% reported last year.

In the case of nine intra-crosses between arabica cultures planted in 1955, eight crosses exhibited leaf disease susceptibility ranging from 7.1 to 43.6% as against 4.7 to 11.3% reported in the previous year. The remaining one intra-cross continued to be free from leaf disease. The F_2 generation of S. 31 arabica selection cross-bred with Kents arabica (S. 333) planted at the same time which was free from leaf disease in the previous year exhibited 9.1% susceptibility during the year under report.

Three out of 16 intra-crosses between arabica cultures planted in 1956 are so far free from leaf disease. The remaining 13 intra-crosses showed leaf disease susceptibility ranging up to 13%. Six cultures of S. 795 (3rd generation) planted at the same time show low, not exceeding 1.7%, leaf disease susceptibility.

Twelve intra-crosses between arabica cultures were planted in 1957. Seven of these were so far free from leaf disease; and, in the remaining 5 crosses, the range of susceptibility varied from 1.6 to 23.1%.

2. Comparative Trials of Seedling Progeny of Selections of B.A. Series

The trial laid out during 1956 with seedling progeny of 20 arabica cultures of B.A. series, as reported in detail in the Annual Report for 1956-57, was continued. All the plants in the plots are free from leaf disease so far,

3. Comparative Trials of Clonal Progeny from Best Performers

(a) *B.A. Series I.*—The randomised replicated trial to test the comparative merits of 20 arabica cultures (B.A. 5, 6, 11, 12, 13, 19 to 27, 30 to 32, and 34 to 36) planted in 1951 and 1952 was continued. The plants continued to be free from leaf disease. The average yields of the cultures in terms of clean coffee per acre are given in Appendix XXIV. B.A. 11, 12, 13, 19 and 23 continued to lead the others as in the previous years.

(b) *B.A. Series II.*—The randomised replicated trial to test the comparative merits of 16 arabica cultures (clonal progeny of B.A. 1, 4, 7, 8 to 10, 13 to 18, 28, 29 and 33, and seedling progeny of B.A. 19) planted during 1952 and 1953 was continued. All the plants are so far free from leaf disease in the field. The average yields of the cultures in terms of clean coffee per acre are given in Appendix XXV. B.A. 28 and 16 are continuing to lead the others as in 1956–57.

4. Observational Studies on the Performance of the Progeny of Outstanding Plants Selected from Private Estates (Field Collections)

(a) Of the 18 collections from Mysore State and Shevaroy (Madras State), four collections from Mysore were discarded as reported during 1956–57 on the basis of high leaf disease susceptibility. The remaining 14 collections have shown susceptibility ranging from 6 to 13% as against 5 to 13% last year. The crop harvested during the year varied from 4.8 to 0.6 cwt. of clean coffee per acre.

(b) The plants from the collections in four estates from Shevaroy (Madras State) and one in Mysore State planted in 1954–55 showed over 60% susceptibility to leaf disease for the second year in succession. Due to the disease, defoliation was also noticed to an appreciable extent. The collections have been discarded and further observations discontinued.

(c) Plants established during 1956 from a collection each from Woger Estate (Mysore State) and Kogilahalla Estate, Coorg (Mysore State), showed 10.3 and 6.4% leaf disease susceptibility as against 10.6 and 38.6% in the previous year. The low percentage of leaf disease susceptibility in the Kogilahalla collections is interesting. Further observations are in progress.

(d) Fifty plants were established during 1957 from two collections from Kotada Estate, Nilgiris, Madras State. They are exhibiting leaf disease susceptibility upto 38%.

(e) Marking of outstanding plants in private estates for seed collection was continued. Six plants have been marked among Seaghalli hybrid plots in Sulgode Estate, Sakalaspur, Mysore State. They are all free from leaf disease and exhibiting vigorous growth.

5. Interspecific Crosses

(a) Study of interspecific hybrids with particular emphasis on the robusta-arabica hybrid, their back-crosses and self-bred progeny was continued. A

co-ordinated study on cytological and morphological characteristics as well as leaf-disease resistance and yield characteristics of these hybrids initiated during last year was continued.

(i) F_1 of *S. 274 Robusta* $\times$ *Kents Arabica*.— F_1 plants show vegetative characters intermediate between the parents. They are vigorous, are free from leaf disease and semi-fertile. In the produce, up to 40% floats and 60% peaberry are found. The chromosome number recorded is $2n = 33$. Meiosis is irregular with formation of univalents and multivalents during pairing. Up to 25% pollen grains of normal size occur.

(ii) *First back-cross of S. 274 Robusta* $\times$ *Kents Arabica with Kents Arabica*.—Among the existing 23 plants there is a high variation in vegetative characters; but in general, they show resemblance to the recurring parent—*Kents Arabica*, and are vigorous growing. 25% of the plants are susceptible to leaf disease. The yields from individual plants vary from nil to 31 cwt. of clean coffee to the acre. Up to 20% floats and 80% peaberries are found in the produce. Twenty-one plants have $2n = 44$ chromosomes, and one each have 33 and 55. Five plants recorded 75% normal size pollen grains; another five showed 40 to 65% normal grains, and the rest have less than 40% normal grains.

(iii) *Second back-cross of S. 274 Robusta* $\times$ *Kents Arabica with Kents Arabica*.—
(1) Thirty-six plants of the second back-cross were established in 1949. All the plants show close resemblance in vegetative characters to the noble parent—*Kents Arabica*. 41% of the plants are susceptible to leaf disease. The remaining 59% plants are free from leaf disease and are vigorous. The yields from individual plants vary from nil to 17.2 cwt. of clean coffee to the acre. Up to 16% floats and 80% peaberry are found in the produce. Six plants examined show $2n = 44$ chromosomes. Four plants recorded 75% normal pollen grains; six plants showed 40 to 65% normal grains and the rest have less than 40% normal grains.
(2) Five plants of the second back-cross were established in 1954. These showed a slight manifestation of leaf disease (less than 1% and in isolated spots) during 1956–57. However, they were free from leaf disease during the year under report.

(iv) *First back-cross of S. 274 Robusta* $\times$ *Kents Arabica with S. 274 robusta*.—Among the existing four plants there is a wide variation but, in general, they show resemblance to the recurring parent, viz., *robusta*. They are vigorous and are free from leaf disease. The yields from individual plants vary from nil to 8.3 cwt. of clean coffee to the acre. Up to 44% floats and 80% peaberries are found in the produce. All the plants show $2n = 44$ chromosomes. One plant recorded 90% normal pollen grains and the others less than 40%.

(v) Progeny from open-pollinated seeds of the highest yielding plant in the first back-cross with *robusta* were established in 1949. The existing 18 plants are all free from leaf disease. Fourteen are vigorous and show close resemblance to the *robusta* parent. Three plants have yielded from 6.1 to 13.3 cwt. clean

coffee to the acre. The rest have yielded less than 2 cwt. clean coffee to the acre. In the produce of the three high yielding plants, up to 14% floats and 69% peaberries are found. Two out of these three plants have over 86% normal pollen grains. All the progeny have $2n = 44$ chromosomes.

(vi) During the year, a selected plant from the first back-cross of S. 274 Robusta $\times$ Kents Arabica with Kents Arabica having $2n = 44$ chromosomes was again back-crossed with Kents Arabica.

Eight selected plants in B.C. I and II of S. 274 Robusta $\times$ Kents Arabica with Kents Arabica and Robusta showing vigorous growth, freedom from leaf disease and high yields ranging from 6.1 to 31 cwt. clean coffee per acre were selected for raising further progeny.

(b) *Devamachy hybrid collections*.—Nine out of ten crosses between Devamachy hybrid collections, arabica selections and other collections reported in earlier Annual Reports (1954–55 and 1955–56) showed susceptibility to leaf disease ranging from 16 to 40%. One cross with Anglo-Egyptian-Sudan collection continued to be free from the disease.

Four crosses between Devamachy hybrid collections and S. 795 and S. 333 were established in 1957. Three are so far free from leaf disease. The remaining cross has exhibited 14.3% leaf disease susceptibility.

II. Robusta

1. Comparative Trials of Seedling Progeny from Best Performers: B.R. Series

The trial laid out during 1956 with seedling progeny of 12 robusta cultures of the B.R. Series described in the Annual Report for 1956–57 was continued. The plants in the trial plots are growing vigorously.

2. Comparative Trials of Clonal Progeny from Best Performers

(a) *B.R. Series I*.—The randomised replicated trial to test the comparative merits of ten robusta cultures (B.R. 2, 3, 5, 6, 7, 9, 11, 12, 15 and 17) planted in 1951 and 1952 was continued. The average yields of the cultures in terms of clean coffee per acre are given in Appendix XXVI. B.R. 6 and 12 are continuing to lead the other cultures in yield.

(b) *B.R. Series II*.—The randomised replicated trial to test the comparative merits of ten robusta cultures (clonal progeny of B.R. 1, 4, 6, 8, 10, 13, 14, 16 and 17 and seedling progeny of S. 274 robusta) planted during 1952 and 1953 was continued. The trees are in initial bearing and yield data are given in Appendix XXVII. Observations are in progress.

3. Observational Studies on the Performance of the Progeny of Outstanding Plants Selected from Private Estates (Field Collections)

Plants raised from seeds of 40 marked plants in Hope Estate, Coorg, Mysore State, were established at Balehonnur Station during 1956. They are showing vigorous growth,

III. Collection of Coffee Seed Material from Countries Outside India

Collection of seeds of coffee species, varieties and selections from countries outside India was continued.

1. World Collections—1953 Series

Bourbon amarelo, Bourbon vermelho, Caturra amarelo, Laurina maragogype and Mundo-Novo continued to show susceptibility to leaf disease under the conditions at the Station. The progeny of Selections B.A. 1, B.A. 12, B.A. 16 and B.A. 19 planted for comparison have shown disease susceptibility ranging from 3.7 to 24.4%. The introduced varieties also suffered from defoliation due to the disease. The Selections have just commenced bearing.

2. World Collections—1954 Series

Twenty-seven varieties of arabica received from Guatemala, Belgian Congo, and Ethiopia, seven arabica selections from Coffee Research and Experimental Station, Lyamungu, Tanganyika and Kawisari B and D from Indonesia planted along with the Station Selections S. 288 and S. 446 continued to be under observation. Most of the arabica collections and S. 446 continued to show susceptibility to leaf disease under the conditions at the Station. A few leaves on 80% of the plants in Tafari-kela and 24.7% plants on S. 12 Kaffa (Ethiopian collections) showed isolated infections of leaf disease. These were free from the disease in the previous year. S. 288 showed 15.2% susceptibility.

The first crop was harvested on brown wood. Variety Padang recorded the maximum of 3.4 cwt. of clean coffee per acre.

3. World Collections—1955 Series

Forty-two arabica varieties, Kawisari B and D, and *C. stenophylla*, *C. canephora*, *Coffea dewevrei excelsa*, *C. racemosa* and *C. ligustroides* collected from Liberia, Belgian Congo, Tanganyika, Portugal and Ceylon continued to be under observation. All the introduced arabica varieties show susceptibility to leaf disease including Wolkite and Arba Gougou which were reported to be free from leaf disease in the previous year. 3.6% of the plants of *C. stenophylla* and 7.4% of *C. dewevrei excelsa* also showed susceptibility to leaf disease.

4. World Collections—1956 Series

Sixty-six varieties, forms and types of arabica, *C. salvatrix*, *C. eugenoides*, *C. canephora*, *C. robusta Lawrentii*, *C. liberica arnoldiana* and *C. liberica aruvimien-sis* obtained from the U.S. Department of Agriculture, Guatemala, Ethiopia, Liberia, Tanganyika, France and Ceylon and planted during 1956 continued to be under observation. Among the arabica collections, Misan Tafari-kela and Eniamba Kaffa from Ethiopia and Sudan Barbuk from Tanganyika continued to be free from leaf disease. All the remaining arabica collections exhibited susceptibility to leaf disease,

5. World Collections—1957 Series

Twenty-seven varieties, forms and types of arabica and *C. canephora* obtained from the U.S. Department of Agriculture, Kenya, Uganda, Brazil, Ethiopia and Viet Nam were planted during 1957. They are under observation.

6. The following seed materials were received during the year under report and seedlings have been raised from them:—

Material obtained	Source
<i>Coffea arabica</i>	Head, Tropical Crops Plant Introduction Section, U.S.D.A. Horticultural Crops Research Branch, Beltsville, Maryland.
1. Wush Wush	
2. Moderele	
3. Boggia	
4. Era	
5. Shebe	
6. BE 10	
7. BE 11	
<i>Coffea rupestris</i>	
<i>Coffea racemosa</i>	.. Dr. Branquinho d'Oliveira (through the good offices of Mr. C. A. Krug, Tropical Crops Specialist, F.A.O., Rome).

7. Collection of coffee material received from 1953 from institutions outside India consists of 121 varieties, forms and selections of arabica coffee, four types of liberica coffee, ten types and selections of robusta coffee, two types of excelsa coffee, Kawisari B and D, congensis, stenophylla, eugenoides, racemosa, salvatrix, kapataka and rupestris. A list of the material is given in Appendix XXVIII.

B. Extension Work with Selections

1. Seed Blocks

(a) The seed blocks established at Balehonnur Station with S. 795, S. 947, S. 532, S. 645 and S. 846 during 1954 and with S. 795 during 1955 were maintained. The plants, particularly S. 795, are showing vigorous and healthy growth. An initial crop of 2.1 cwt. to the acre of clean coffee developed on brown wood was harvested from S. 795 planted in 1954.

(b) The scheme of establishing zonal seed plots of Station Selections on private estates initiated during 1954–55 to help in meeting the increasing demand for seeds was continued in respect of S. 795. The demand for seeds of all other Station Selections was met from the seed produced at the two Stations. During the year, seed coffee of S. 795 was collected in the zonal seed plots in the following estates. Off-type plants in these seed plots were rogued out and seed coffee prepared under the supervision of the Research Department.

Mysore State

1. Bagneheddal Estate, Chikmagalur P.O.
2. Urvinkhan Estate, Javali P.O.

3. Kogarvalli Estate, Sakalaspur P.O.
4. Kibbetta Estate, Somwarpet P.O.
5. Balagunda Estate, Somwarpet P.O.
6. Madapur 'A' Estate, Madapur P.O.
7. Haradoor Estate, Suntikoppa P.O.
8. Pannia Estate, Suntikoppa P.O.

Madras State

9. Glenvans Estate, Ouchterlony Valley Estates (1938) Ltd., New Hope P.O., Nilgiris.

1,210 lb. seeds of arabica selections, 760 lb. seeds of robusta selections, and 14 lb. seeds of excelsa were prepared at Balehonnur Station and delivered to the Senior Liaison Officer (Development) for distribution.

2. Twenty-two pounds seeds of arabica selections were supplied to (1) Senior Research Officer, Coffee Research Station, Department of Agriculture, Ruiru, Kenya, (2) The Hon'ble Minister of Agriculture, Government of Viet Nam, Saigon, (3) the United States Operation Mission, Laos (through the good offices of the American Consulate-General, Madras), (4) the United States Technical Co-operation Mission, American Embassy, Taiwan, Formosa (through the good offices of Procurement and Supply Officer, American Embassy, New Delhi) and (5) China National Tea Export Corporation [through the good offices of the State Trading Corporation India (Private) Ltd., New Delhi].

C. Vegetative Propagation

1. Grafting

Trials to find an easy technique for grafting on robusta or moribund or hybrid stocks were continued.

The technique of top-working at 12 to 15 inches height from the ground level on tender green suckers of not more than three months growth arising on mature robusta plants without stumping, was pursued, since this technique accords considerable economy in time and care.

Rehabilitation by grafting technique attempted in earlier years in private estates was further extended. Demonstrations in the technique were given in five private estates in Mudigere, Sakalaspur and South Coorg zones in Mysore State where grafting is being attempted on a field scale.

Grafting demonstrations for estate workers, writers and others were held as in the previous years at both the Research Stations in the last week of May and the first week of June, 1958. Over 50 visitors attended these demonstrations.

2. Rooting of Sucker Cuttings

(a) 715 rooted cuttings from S. 26, S. 31, B.A. 6, S. 288, and S. 795 were produced during the year and were utilised for planting in experimental plots.

(b) Two proprietary products, viz., Seradix L. 15 and L. 30 and cow's urine extract were used for treating single-noded sucker-cuttings before inserting them for rooting in propagation chambers. Treatment with Seradix L. 15 gave 71% rooting, with Seradix L. 30 61.1% and with cow's urine extract 62.2%. The treatments are significantly superior to the control (untreated) which gave 45.6% rooting. The trial will be continued.

D. Multiple vs. Single Stem System of Growing Coffee

Training coffee on multiple stem is a common practice in Central American and East African coffee areas. The main advantages are reported to be regular and controlled cropping and the ease of pruning. With a view to gain local experience and knowledge, four sets of experiments were laid out at Balehonnur during the years 1950 and 1951 to compare the single stem and multiple stem systems of growing coffee on both arabica and robusta. Unlike in other countries, the coffee in these experimental plots is grown under mixed shade.

(a) **Arabica.**—In three trials extending over seven years, it was observed that in two trials the yields from the multiple stem plots was less than the single stem plots by 16.8 and 0.5% respectively, while in the third the former has yielded over the latter by about 8.1%. The yield data of the experiments are furnished in Appendices XXIX, XXX and XXXI. It was also interesting to observe that where adequate protection has been taken against stem borer, the incidence was low irrespective of the system of training adopted.

(b) **Robusta.**—This experiment started in 1951 as described in the earlier reports was continued. The sixth crop after conversion was recorded. Yield data are given in Appendix XXXII.

The single stem plots have recorded 58.7% increase in yield over the multiple stem plots on the basis of six years' average yields. Shot-hole borer infestation on multiple stem plots continued to be heavy as in the previous years and a number of branches had to be cut and destroyed.

E. Laboratory Studies

Cytological studies were continued to define the chromosomal make-up of species, varieties, selections and interspecific hybrids of coffee. These were co-ordinated with morphological studies to help in the coffee breeding programme.

1. Studies on Interspecific Hybrid

The following continued to be under study:—

- (i) S. 594— F_1 of S. 274, 1/11 Robusta $\times$ S. 450, 2/1 Kents Arabica.
- (ii) S. 905— BC_1 with Kents Arabica (S. 594-2 $\times$ S. 450, 2/1 Kents Arabica).
- (iii) S. 908— BC_1 with Robusta (S. 594-2 $\times$ S. 274, 1/11 Robusta).

(a) The F_1 , S. 594, shows $2n = 33$ chromosomes. The pairing of the chromosomes in meiosis is highly irregular. One to five trivalents, 2 to 10 bivalents and

4 to 21 univalents occur. Maximum trivalent formation was noticed in 33.3% pollen mother cells and maximum bivalent formation in 11.1% pollen mother cells. During the first anaphase up to 16 laggards were found; in up to 41.6% cases in second anaphase, 22 chromosomes were noticed.

(b) BC_1 with either Kents arabica or robusta showed $2n = 44$ chromosomes. This is maintained in BC_2 with Kents arabica. In spite of the tetraploidy, 60 to 70% normal sized (31.2μ) pollen grains are produced only in up to 16% plants.

(c) Analysis of developing fruits in these crosses indicated occurrence of "false polyembryony" up to 5%. This was due to the development of more than one ovule in each locule.

2. Studies on Kents Arabica

(a) Analysis of pollen grains in pedigree Kents arabica has indicated the occurrence of 82 to 95% normal pollen (measuring 31.2μ) grains. It is interesting to record the occurrence in a few cases of *in situ* germination of pollen grains a day or two prior to anthesis. This has also been observed in Coorg arabica and in Station Selections, S. 795 and S. 288.

(b) A haploid arabica plant with $2n = 22$ chromosomes was isolated. It is similar in vegetative characters to the tetraploid Kents except that all parts are smaller in size. Only a few peaberries occur in this plant.

Further observations are in progress.

3. Tetraploidy in Robusta Induced by Colchicine Treatment

As reported in the earlier reports, the two robusta plants in which doubling of chromosomes was induced by treatment with colchicine continued to be under study. In one of the plants, the doubled chromosome number remains constant. In the second plant, contiguous sectors with diploid and tetraploid numbers are observed. During the year, the plants came to flower. The plant with complete tetraploidy has bigger flowers with 6 to 7 stamens and corolla lobes. The plant with variegated diploid and tetraploid tissues has smaller flowers with 5 to 6 stamens and corolla lobes. Meiotic studies are in progress.

4. Triage Studies in Coffee

Preliminary cytological, embryological, morphological and co-ordinated observational studies have been done in the previous year and during the year under report on Station Selections with a view to define and fix the characteristics of the parent material and thus enable selection of further parents in the plant breeding work. A detailed study of the behaviour of the fruit from floral stage to the mature fruit was also initiated. These studies have been carried out on an *ad hoc* basis and the progress was not commensurate with the requirements. Therefore, during June 1958, a project was initiated with special staff to carry out the work more expeditiously. The study is proposed on the following lines:—

- (i) Study of the development of locules and ovules in the ovary;
- (ii) Study of the comparative embryology of Kents arabica, Coorg arabica and Station Selections S. 795 and S. 288;
- (iii) Study of the extent of hybridity in S. 795, S. 288 and Kents arabica;
- (iv) Study of the positional effect on fruit development leading on to triage;
- (v) Study of the nutritional effects on fruit development leading on to triage; and
- (vi) Study of the climatic factors inducing triage production.

F. Miscellaneous Crops

Shade Trees for Coffee

(a) Seventeen pounds seeds of *Masopsis eminii* were supplied to two planters and to the District Agricultural Officer, South Kanara District, Mysore State.

Seedlings of *Albizzia maranguensis* and *A. coriaria* were supplied to one planter in North-East Monsoon zones in Nilgiris for trial.

(b) Cuttings of *Erythrina* sp. and seeds of *Acacia elata* were obtained through the courtesy of the General Manager, Kannan Devan Hills Produce Co. Ltd., Munnar, Kerala State, and seeds of *Albizzia sumatrana* through the courtesy of the Scientific Officer, U.P.A.S.I., Tea Experiment Station, Devarshola, Nilgiris.

(c) Seedlings of *Schizalobium parahybum*, *Peptadenia macrocarpa* and *Erythrina speciosa* were raised from seeds obtained through the courtesy of the Director, Instituto Agronomico Do Estado de Sao Paulo, Brazil.

(d) In the shade collections at the Balehonnur Station the following are included:—

Erythrina speciosa, *E. tomentosa*, *E. torulosa*, *E. sp.*, *Albizzia maranguensis*, *A. coriaria*, *A. sumatrana*, *Acacia elata*, *Entada abyssynica*, *Milletia oblata*, *Cassia javanica*, *Cordia abyssinica*, *Ruprechtia vivoru*, *Trema guienensis* and *Machærum tipu*.

G. Experiments at the Coffee Research Sub-Station, Chethalli

Varietal Trails

The varietal trial laid out in 1949 to test the Station Selections S. 795, S. 288, S. 645 and S. 446 as described in the earlier Annual Reports was continued. The seventh crop from these plots was harvested. The data are given in Appendix XXXIII. S. 795 is continuing to give consistently high yields for the past 3 years in succession from 1956. S. 645 has closely followed S. 795 in its wake.

R. L. NARASIMHASWAMY,
Botanist.

III. CHEMISTRY

Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on growth and health factors, moisture and temperature on the opening of blossoms, hormones on fruit-set and studies on the processing of coffee formed the main items of work of this division. The division also attended to the routine examination of soils for advisory work and undertook visits to problem areas for investigation and advice on soil and crop husbandry.

Field Experiments

A. Manurial Experiments

(i) Studies on the Essential Requirements of Plant Foods NPK for Coffee in Relation to Improvement in Yield (New Manurial Series)

This experiment was laid out in the year 1937 and has completed 18 years of observation. As reported earlier in the Annual Report for 1954-55, plant population in each plot was halved from 40 to 20 plants. The yields have first been calculated on the present population of 20 plants and equated to the original population of 40 plants for purposes of comparison over the years. The results are summarised in Appendix XXXIV.

It is seen that treatments $N + P$ and $N + P + K$ are significantly superior to control. The treatment $N + P$ is also significantly superior to treatments receiving N alone and $N + K$ but not to $N + P + K$. However, treatment $N + P + K$ is superior numerically to the treatments N and $N + K$.

It is interesting to observe that over the eighteen-year period of experimentation, the average yields of ripe cherry (fruits) in all the treatments are significantly superior to the control; more interesting is that treatments having P_2O_5 , viz., $N + P$ and $N + P + K$ are again significantly superior to treatments having no P_2O_5 . An analysis of yield of clean coffee over a ten-year period further supports this observation. There does not seem to be any noticeable correlation between treatments and floats.

The following trends noticed in the previous years continued to operate in the year under report, viz., (1) Yield increases over control have been steady in the case of NP, (2) phosphates seem to help in the better utilization of nitrogen and (3) application of nitrogen alone does not seem to produce increases in crop proportionate to the increase of the fertilizer applied.

(ii) Studies on the Manurial Requirements of Coffee in Relation to Improvement in Yield

(a) *NPK trial with varying levels of N, P and K (Fundamental Manurial Experiments—Single plant experiments in cisterns).*—This experiment laid out in 1950 was continued. Full details of the experiment have been furnished in the

Annual Report for 1953-54. The yield records and the percentage of floats are given in Appendix XXXV.

The treatments are not significant. An examination of the average yields over the five-year period since the first crop was picked, shows that treatments have not been significant. Nevertheless, it is interesting that treatment F (N_2 45 lb., P_2O_5 67.5 lb. and K_2O 90.0 lb.) has given numerically appreciably higher yields than all other treatments so far, confirming the earlier observations.

(b) *NPK trial with varying levels of nitrogen with constant levels of P and K (17-acre Manurial Experiments—1952 Series).*—This experiment started in the year 1952 was continued. The running blossom reported in the Tenth Annual Report for 1956-57 resulted in a very poor crop. The yield records of the experiment are given in Appendix XXXVI. Treatments have not been significant. Treatment B (80 N_2 30 P_2O_5 40 K_2O) has given numerically the highest yields of both ripe cherry and clean coffee, being more than double that of control. Treatment B is followed by treatments E (40 N_2 30 P_2O_5 40 K_2O), D (60 N_2 30 P_2O_5 40 K_2O) and C (100 N_2 30 P_2O_5 40 K_2O) successively.

(c) *NPK trials with constant levels of N.P.K. but varying sources of nitrogen (17-acre Manurial Experiments—1953 Series).*—This experiment started in 1953 was continued. The first full crop picked from the 1957 harvest was very small and was the result of an indifferent and patchy blossom. Therefore the results have been merely recorded.

(d) *NPK trials with varying levels of P and K and constant levels of nitrogen (17-acre Manurial Experiments—1954 Series).*—During the blossom of 1957 the flowers on the brown wood only were retained, that on green wood being rubbed off. The yield from the plots has been recorded.

(e) *NPK trials with varying levels and combinations (Arabica manurial experiment at the Coffee Research Substation, Chethalli, Coorg).*—This experiment started in 1952 was continued. The yield record of the experiment is given in Appendix XXXVII.

It will be seen from the data that after the heavy yield of 17 to 18 cwt. per acre, the yield during the year under report has been about 6 cwt. per acre. In the statistical analysis carried out it has been found that treatments have not been significant. The significant difference between blocks observed last year is not noticed this year. The results of the statistical analysis of the data are as follows:—

- (1) None of the factors are statistically significant.
- (2) Main effect due to nitrogen misses significance very narrowly.
- (3) An increase in yield is noticed with increase in nitrogen applied, the highest yields being obtained in case of treatments N_3 (120 lb. per acre) and N_2 (90 lb. per acre). The difference in yield between N_3 (120 lb. per acre) and N_2 (90 lb. per acre) is very small.
- (4) A decrease in yield is noticed with increase in applications of P & K.

(f) *Studies on the effect of aldrinized fertilizers on yield of coffee.*—The two experiments have been described in detail in the Ninth Annual Report for the year 1955–56. The yield records of the experiments located at the Coffee Research Station, Balehonnur, and at the Coffee Research Substation, Chethalli, are given in Appendix XXXVIII. The treatments in both the experiments have not been significant. At Balehonnur, treatment D ($80 \text{ N}_2 + 45 \text{ P}_2\text{O}_5 + 60 \text{ K}_2\text{O} + 1 \text{ lb. aldrin}$) is numerically superior to the rest of the treatments in the two years while at Chethalli, treatment C ($80 \text{ N}_2 + 45 \text{ P}_2\text{O}_5 + 60 \text{ K}_2\text{O} + 1.5 \text{ lb. aldrin}$) is numerically superior to the rest in 1958 whilst D was superior in 1957. In both the Stations treatment B ($80 \text{ N}_2 + 45 \text{ P}_2\text{O}_5 + 60 \text{ K}_2\text{O} + 2.5 \text{ lb. aldrin}$) is the lowest.

(g) *Test-scale trials at Coffee Research Substation, Chethalli.*—This experiment described in the Eighth Annual Report for the year 1954–55, was continued. The yield data from the experiment are furnished below:—

Treatment	Block 1 Nitrogen applied in 2 equal doses P & K in 2 equal doses	Block 2 Nitrogen applied in 3 equal doses P & K in 2 equal doses	Mean yield of ripe cherry in lb. per acre
N_1 (40 lb./acre)	.. 3568 lb. of ripe cherry per acre	4473 lb./acre	4021
N_2 (60 lb. N/acre)	.. 4093 do.	4840 do.	4467
N_3 (80 lb. „)	.. 4749 do.	4095 do.	4422
N_4 (100 lb. „)	.. 3981 do.	6323 do.	5152
$\text{N}_2 + \text{P}$ (60 N+30 P_2O_5)	2353 do.	3379 do.	2866
$\text{N}_3 + \text{P} + \text{K}$ (60 N+30 P_2O_5 + 40 K_2O)	.. 4975 do.	4571 do.	4773

It will be seen from the above that (1) nitrogen applied in three doses has been more beneficial than in two doses, (2) with an increase in the quantity of nitrogen applied there has been an increase in crop.

(h) *Test-scale observational trials on the effect of increasing doses of manure on coffee.*—The two trials one on arabica and the other on robusta, laid out and started in May 1956, were continued. Details of the trials are given in the Ninth Annual Report for 1955–56. The yields for 1957–58 do not show any regular pattern of response to manuring.

(iii) Field Trials to Find Out the Maximum Economic Dose of Nitrogen and the Role of Phosphates and Potash in Balancing Nitrogen Utilization

This trial started in May 1956 was continued. Details of the trial are given in the Ninth Annual Report. The yield data from the experiment are given in Appendix XXXIX. It will be seen from the data that one of the treatments—Treatment C (200 lb. nitrogen per acre) has been significantly superior to E 400 lb.

N per acre) and is numerically superior to the rest. The sub-treatments have not been significant. However, sub-treatment 2 (N + P + K plus 1 lb. rock phosphate per plant given as basal dressing at the commencement of the experiment) is numerically superior to the rest.

(iv) Field Trials on Private Estates

(a) *Studies on the application of nitrogen only in divided doses in relation to yield of coffee.*—This experiment laid out in 1953 in one of the private estates (Ossoor Estate, Sakalaspur, Mysore) was continued. The yield records of the experiment are given in Appendix XL. The treatments have not been significant this year also and in the analysis of the average yield over 5 years. The experiment has been concluded.

(b) *Effect of different sources of nitrogen on the growth and yield of mature yielding coffee.*—This experiment started in April 1956 in the Shigode Estate near the Coffee Research Station, Balehonnur, was continued. The yield record of the experiment is given in Appendix XLI. The treatments have not been significant. However, treatment C (Ammonium sulphate) has given numerically the highest yield.

(v) Field Manurial Trials in Private Estates—Arabica

The trials started in 1954 on ten private estates (except for one which was abandoned) situated in different soil and climatic zones of the coffee growing tracts of South India were continued. The yield records of the harvests for 1957 and 1958 are given in Appendix XLII (A). In the analysis in 4 localities there exists a significant difference between blocks. The progressive reduction in this from year to year shows that the initial differences in fertility are being levelled out. With the solitary exception of Vasambadi Estate in the Shevaroyes the treatments have not been significant. The following trends are, however, noted:—

- (1) In the 9 experiments over two years numerical superiority of treatments having P (*i.e.*, NP or NPK) over other treatments is seen in 13 out of 18 cases.
- (2) In 6 cases out of 18, treatment A is numerically superior to the rest whilst treatment C in 5 cases, treatment D in 4 cases and treatment B in 3 cases out of 18 have been numerically superior to the rest.

Average yields from these several experiments expressed as percentage of nitrogen are furnished in Appendix XLII (B).

It is seen that treatment N + P has in general given higher yields than treatment N only. At a basic level of 30 lb. P, and at 40 and 60 lb. levels of nitrogen, increased numerical yields are noticed in seven out of nine trials, while at the higher levels of 80 and 100 lb. of nitrogen, there is a noticeable recession in the number of such cases. It is of interest whether a proportionate increase in phosphate application may not be necessary at nitrogen levels higher than 60 lb. to the acre

With the addition of a basic dose of 40 lb. of potash to the acre to form a complete NPK mixture, increased numerical yields are noticed only in five out of these nine trials when the nitrogen level is at 60 lb. At lower and higher levels of nitrogen than 60 lb., there is a sharp fall to four out of nine at 40 lb. and two and three out of nine at 80 and 100 lb. nitrogen respectively.

(vi) Manurial Experiments on Robusta Coffee

(a) *NPK trials with varying levels and combinations—Coffee Research Substation, Chethalli.*—This trial started in 1954 was continued. During the blossom of 1957, only the buds on the brown wood were retained whilst that on green wood was rubbed off. Yields from the first crop have been recorded.

(b) *Field manurial trials on robusta coffee.*—The trials started in 1955 in four private estates in Wynaad (Kerala) and one in Sakalaspur (Mysore) were continued. The yield data from the harvests of 1956–57 and 1957–58 are presented in Appendix XLIII. It is seen that the results have not been significant in the case of both main and sub-treatments except in the trial at North Carolina Estate, where the sub-treatments are significant. It is, however, interesting to observe that the yield differences between the blocks are significant in four out of these five trials.

The yield data from the treatments NP and NPK at different levels of nitrogen have been rearranged as percentage of the mean of N_1 and N_2 .

Treatments		Calculated yield of ripe cherry per acre as % of mean of N_1 and N_2					Mean of five estates
		Krishna	North Carolina	Pathri- para	Chellote	Sulgode	
Main	Sub						
40 lb. N_2 /acre ..	(N)	100	100	100	100	100	100
40 lb. ,, + 30 lb. P_2O_5 ..	(NP)	111	81	106	130	91	104
40 lb. ,, + 30 lb. P_2O_5 + 40 lb. K_2O ..	(NPK)	95	122	123	138	96	115
60 lb. N_2 /acre ..	(N)	100	100	100	100	100	100
60 lb. ,, + 30 lb. P_2O_5 ..	(NP)	74	94	100	112	100	96
60 lb. ,, + 30 lb. P_2O_5 + 40 lb. K_2O ..	(NPK)	113	130	77	124	101	109
80 lb. N_2 /acre ..	(N)	100	100	100	100	100	100
80 lb. ,, + 30 lb. P_2O_5 ..	(NP)	69	111	110	84	124	99.6
80 lb. ,, + 30 lb. P_2O_5 + 40 lb. K_2O ..	(NPK)	133	133	119	145	115	129
100 lb. N_2 /acre ..	(N)	100	100	100	100	100	100
100 lb. ,, + 30 lb. P_2O_5 ..	(NP)	116	96	76	110	118	103.2
100 lb. ,, + 30 lb. P_2O_5 + 40 lb. K_2O ..	(NPK)	105	132	136	145	137	131

It is seen that (1) at all levels of nitrogen, an application of a complete mixture of NPK has given numerically the highest yields in most cases; (2) at 100 lb. of nitrogen per acre, increased numerical yields are noticed in 4 out of 5 cases whereas at decreasing levels of nitrogen at 80, 60 and 40 lb. such increases are noticeable only in 3 out of 5 cases and (3) with the omission of potash and the application of NP only, percentage increases in yields are noticed in 3 out of 5 cases at all levels of nitrogen *plus* 30 lb. P_2O_5 .

(c) *Field trials on robusta coffee (Modified robusta manurial trials):* (1) *Series I.*—The field trials started in Malabar Wynaad (Kerala), Coorg and Mysore in 1956 were continued. The yield data from the experiments are presented in Appendix XLIV. The treatments have not been significant except in the case of Huvinkadu Estate in Coorg. It is further seen from the data that treatment A (40 lb. N_2 30 lb. P_2O_5 40 lb. K_2O) is numerically superior to the rest in 3 cases out of 7.

(2) *Series II.*—The yield data from the experiment are presented in Appendix XLV. It will be seen from the table that treatments have been significant in four out of five estates. The results are, however, conflicting and only in 2 cases out of 5 has treatment B (NP) been superior to the rest and in the rest of the cases treatments A, D and E are of equal order.

The mean yields in the case of all treatments from the five estates are higher than control and the highest yields are from NPK and PK plots while NP and NK are lower than N only. This would point out the need for an application of all the three major plant foods to robusta.

(vii) Exploratory Trial on the Effect of Foliar Applications of Plant Foods to Coffee in Relation to Growth and Yield

The trial was started in May 1956 and details of the trials are given in the Ninth Annual Report for the year 1955-56. The yield records of the experiment are furnished in Appendix XLVI (A). Treatments have not been significant. This year, treatment F (N_2K_2) is leading and is followed by E (N_1K_1) as against I (Control), E (N_1K_1) and D (N_2P_2) in last year. This year treatment I (Control) is last but one, the last being B (N_2). The observations on the survival from blossom to berry are presented in Appendix XLVI (B). The treatments here also are not significant. Treatment F (N_2K_2) heads the list followed by I (Control) and E (N_1K_1).

(viii) Experiments on the Response to Manuring of Coffee Seedlings in the Nursery

(a) *NPK trials with varying levels and combinations.*—Uniform plants from Nursery Manurial Trial started in 1956 have been planted with soil from the respective plots in the pots. Observations on growth, etc., are being maintained. The first crop is expected to be picked in the winter of 1958.

(b) *Studies to find out the maximum utilizable dose of nitrogen by young coffee seedlings with and without the addition of phosphorus and potash.*—This experiment

started in March 1957 has been described in detail in the Tenth Annual Report for the year 1956-57.

Two sets of growth measurements were taken, one in the field on tagged plants and the second on the plants removed periodically with roots for analysis in the laboratory. The data are presented in Appendix XLVII. In both the cases treatments have been significant.

Main treatment N_0 is significantly superior to the rest with respect to growth measurements recorded in the field while treatments N_1 (12 lb. nitrogen per acre/year), N_2 (24 lb. nitrogen per acre/year) and N_3 (48 lb. nitrogen per acre/year) are *on par*. Treatment N_0 is superior to the rest with respect to growth measurements recorded in the laboratory, but it is *on par* with treatment N_1 .

In the case of sub-treatments with respect to growth measurements recorded in the laboratory treatment N is significantly superior to NPK. In the case of growth measurements recorded in the field (growth above ground level) the sub-treatments have not been significant.

The soil used was a mixture of two parts jungle soil, one part cherry husk compost and one part ordinary soil. The chemical and mechanical analyses of the mixture are given below:—

Chemical analysis				Mechanical analysis			
Moisture	..	..	4.04%	Moisture	..	..	4.04%
Loss on Ignition	..	..	10.61%	pH	..	..	6.1 & 6.7
Insolubles (in HCl)	..	..	72.63%	Silt	..	..	6.11%
pH	..	..	6.1 & 6.7	Clay	..	..	18.55%
Total Nitrogen	..	..	0.335%	Fine Fraction (Silt and Clay)	..	..	24.66%
Total P_2O_5	..	..	0.490%	Fine Sand	..	..	22.12%
Total K_2O	..	..	0.180%	Coarse Sand	..	..	31.48%
Organic Carbon	..	..	4.20%	Coarse Fraction (Fine sand			
C/N Ratio	..	..	12.54	+ Coarse sand)	..	..	53.60%
				Coarse Fraction	..	..	2.174
				Fine Fraction	..	..	17.7%
				Loss by Solution	..	..	

It will be seen from the above that the initial fertility was quite high and conditions for good growth of coffee were optimum. It would therefore appear that provided good drainage is arranged and a rich medium is employed at the time of planting, there is no necessity for application of further quantities of manures.

(ix) Field Trials on the Effect of Minor Elements on the Growth and Yield of Coffee (Experiment with Chelates)

This experiment started in July 1957 was continued. Details of the experiment are furnished in the Tenth Annual Report. The first application of Chelates

and manures was carried out in September 1957. Visual observations so far show no differences in growth.

B. Cultural Experiments

(i) Studies on Growth and Yield of Coffee in Relation to Shade Requirement— Hedge Row System of Planting

The experiment started in 1953 was continued. A total crop of 4.23 cwt. of clean coffee was picked from the block. The area under shade yielded more crop than the block in the open. The yield in terms of clean coffee per acre calculated on the number of bearing plants works out to 15.8 and 16.3 cwt. in the open and shade respectively.

Observations on soil moisture tension showed the following trends:—

- (1) The midday temperatures were invariably higher in the open than under shade, there being practically no differences in the morning and evening temperatures. Soil temperatures were almost the same;
- (2) soil moisture readings showed considerable differences between the open and under shade;
- (3) competition for soil moisture exists between shade trees and coffee; and
- (4) plants in the open stand to benefit more from small showers than those under shade, as practically all the rain-water reaches the soil without being caught and evaporated by the shade trees.

(ii) Studies on Fruit Set in Coffee

This experiment started in March 1956 was continued. The details of the experiment are given in the Ninth Annual Report. The yield record of the experiment is given in Appendix XLVIII. In arabica the treatments have not been significant in all the three applications. Treatment E (0.26 lb., Duraset Dust/100 lb. talc) leads in both the pre-blossom and post-blossom application and stands second in the “at petal fall” application. In robusta the treatments have not also been significant in all the three applications. In the pre-blossom application treatment F (0.52 lb., Duraset Dust/100 lb. talc) is second whilst in the petal fall application it is first, whilst treatment E (0.26 lb., Duraset dust/100 lb. talc) is last in pre-blossom and “at petal fall” applications.

The experiment has been concluded.

(iii) Demonstration Trials

(a) *Arabica*.—An examination of the data for the year 1957–58 shows that there is little difference in the crop harvested from the different treatments. However, treatment with 520 lb. nitrogen, 312 lb. P_2O_5 and 416 lb. K_2O to the acre has recorded the highest yield closely followed by treatment 120 lb. nitrogen, 72 lb. P_2O_5 and 96 lb. K_2O to the acre,

(b) *Robusta*.—Treatment with 480 lb. nitrogen, 360 lb. P_2O_5 and 480 lb. K_2O has given the highest yield followed by 280 lb. nitrogen, 210 lb. P_2O_5 and 280 lb. K_2O to the acre.

Discharge from the New Manurial Series Drains

By the 15th July, 1958 a rainfall of 46·50" had fallen over a period of 32 days. The subsoil drains in the New Manurial Series commenced discharging on the 14th July in the night and continued to do so till the end of the month. Measurements were taken of the quantity of water that was being discharged daily and samples of water have been collected for analysis. It is computed that a total quantity of 1,130,860 gallons had flown through the drains during the fortnight commencing from 15th July.

Laboratory

Work in the laboratory consisted mainly of analysis of soil and plant samples collected by the division and soil samples sent by the Director of Cinchona Cultivation, West Bengal.

(a) Seasonal Variations in the Availability of Phosphates and Potash in Coffee Soils under Different Shade Trees

The study started in May 1956 to find out seasonal variations in the availability of phosphates and potash, exchangeable bases in soils under six shade trees commonly grown in coffee plantations has been carried out over a period of 13 months. Soil samples were collected every month from under the shade trees marked for the purpose in three estates and the available P_2O_5 , K_2O , total exchangeable bases, pH, organic carbon, total nitrogen, moisture, and loss on ignition determined. Mechanical analysis, total R_2O_3 , total Fe_2O_3 , total MgO and total CaO were determined in the first, seventh and thirteenth sets of samples. C/N ratio and total Al_2O_3 were calculated. The results obtained are presented in Appendix XLIX (A) and (B).

Mechanical analysis.—The fine fraction is comparatively more under *Albizzia stipulata*, *Bischofia javanica* and *Erythrina lithosperma*. The coarse fraction to fine fraction ratio is also less than unity in these three cases indicating a tendency to be more clayey. A good loamy texture is maintained under *Artocarpus integra*, *Grevillea robusta* and *Ficus glomerata* in the order mentioned.

Total P_2O_5 .—Total P_2O_5 is found to be good under *Erythrina lithosperma*, *Bischofia javanica* and *Ficus glomerata* in the order mentioned; the poorest appears to be under *Grevillea robusta*.

Total K_2O .—The most uniform content is under *Ficus glomerata* and *Grevillea robusta*; the others show an increase in November and a fall by following May.

Total CaO .—Total CaO is uniformly high under *Ficus glomerata*, *Erythrina lithosperma* and *Bischofia javanica*. Under *Albizzia stipulata* and *Artocarpus integra*

it started off a little low and was high in following November and May. Under *Grevillea robusta* it is comparatively lower than under other shade trees.

Total MgO.—Uniformly good values for MgO are found in the soils under *Ficus glomerata* followed closely by *Grevillea robusta*. Comparatively lower but good and uniform values are found under *Albizzia stipulata* and *Erythrina lithosperma*.

Total Fe₂O₃.—Total Fe₂O₃ is highest under *Erythrina lithosperma* and is closely followed by *Bischofia javanica*. The lowest figures amongst the shade trees studied are found under *Ficus glomerata*.

Total Al₂O₃.—Soils under *Erythrina lithosperma* show the most constant values. The lowest figures are found under *Grevillea robusta* and *Bischofia javanica*.

Total nitrogen.—Total nitrogen is uniformly higher under *Ficus glomerata* and *Bischofia javanica*. The next best are *Erythrina lithosperma* and *Albizzia stipulata*.

Total exchangeable bases.—Total exchangeable bases are comparatively high and more uniform under *Ficus glomerata* than under others. The next best are *Erythrina lithosperma* and *Albizzia stipulata*.

Organic carbon.—Values for organic carbon are comparatively high and more uniform under *Ficus glomerata*. The next best are *Bischofia javanica* and *Grevillea robusta*. Under the legumes the variations are very great.

pH.—The values for pH follow more or less the same path under the different shade trees, the variations corresponding to the season.

Available P₂O₅.—The available P₂O₅ content of the soil varies with the season. Lesser fluctuations are seen under *Ficus glomerata* than under any other shade trees. It would appear as though during dry months there is a better availability than in the wet months.

Available K₂O.—Availability of K₂O follows the seasonal variations. Thus there are two periods when it is low, *i.e.*, during July-August and again between October and December. Soil under *Ficus glomerata* shows comparatively higher and more uniform availability, the next being that under *Grevillea robusta* and *Erythrina lithosperma*.

Summing up the above observations, it may be stated that plant nutrients were in general better available and in greater and more uniform quantities under *Ficus glomerata*, *Bischofia javanica*, *Albizzia stipulata* and *Erythrina lithosperma* in the order mentioned.

(b) Studies on the Foliar Feeding of Plant Nutrients

Leaf samples were collected in May 1957 from the plants receiving foliar applications of nitrogen, phosphorus and potassium as described in the Ninth Annual Report for 1955-56, prior to application of treatments, 24 hours, 48 hours and 96 hours after the application of treatments. The values for total nitrogen

are given in the Tenth Annual Report. Analyses of the leaf samples collected prior to treatments and 24 hours after treatment have been completed. The results are furnished in Appendix L.

It will be seen from the data presented that in the case of (i) *young leaves*: (1) there is a general increase in the P_2O_5 content from the first set to the second (before and 24 hours after the application of treatments), in all the treatments except treatment B (N_2), i.e., 40 lb./acre; maximum increase in P_2O_5 content was noticed in treatment F (N_2K_2 —40 lb. nitrogen + 40 lb. potash) closely followed by H ($N_2P_2K_2$ —40 lb. nitrogen + 30 lb. P_2O_5 + 40 lb. K_2O), G ($N_1P_1K_1$ —20 lb. nitrogen + 15 lb. P_2O_5 + 20 lb. K_2O) and E (N_1K_1); (2) an increase in the K_2O content is noticed in all treatments with the exception of B (N_2), C (N_1P_1) and I (Control). The highest increase in K_2O content was noticed in treatment H ($N_2P_2K_2$) while in the case of treatments B (N_2), C (N_1P_1) and I (Control) there was a decrease; (ii) *Old leaves*: There is in general an increase in the P_2O_5 content from the first to the second set. Treatment G ($N_1P_1K_1$) recorded the highest percentage increase closely followed by treatment D (N_2P_2), while treatment C (N_1P_1) recorded the lowest. It is interesting to note that, while absorption of phosphorus took place in both young and old leaves, the old leaves absorbed phosphorus better than the young leaves. Further work is under progress.

(c) Studies on the Development of Spikes and Blossom in Coffee

(1) The details of the experiment are furnished in the Tenth Annual Report for the year 1956–57. The results of the analysis are given in Appendix LI (a). It will be noticed from the data that:—

Organic carbon.—The organic carbon content of the buds reduces as the buds develop in the case of S. 288 whilst the behaviour in the case of Kents is irregular and that generally the organic carbon content of buds collected from S. 288 is higher than that of Kents.

Ash.—The ash percentage in the blossoms of control in both Kents and S. 288 follows parallel paths; in the case of Kents while treatment II shows a continuous rise, in treatment III there is a drop from the 6th to the 8th day and in the case of S. 288 there is continuous rise in treatment III whilst in treatments I and II there is a drop on the 4th day.

P_2O_5 .—In the case of Kents, the P_2O_5 content increases till the 4th day and then decreases, the only exception being in the case of treatment I where it increases up to the 6th day. In the case of S. 288, the P_2O_5 content increases steadily in treatment 0 (control). In the case of treatment III there is a decrease on the 6th day and a rise again. In the case of treatments I and II there is a fall on the 4th day and a rise on the 6th while a rise is noticed on the 8th day in the case of treatment II and a fall on the same day in the case of treatment I. The S. 288 blossoms contained more P_2O_5 than the Kents on the 8th day.

K_2O .—In the case of Kents there is a fall up to the 6th day and there is a rise in the case of treatment 0; in treatments I and III there is a rise up to the 6th

day and then a fall; in the case of Treatment II there is a steady rise. In the case of S. 288 there is a steady increase in Treatment III; in Treatments 0, I and II there is a fall on the 4th day, a rise from then on except with I which drops again; and the Kents blossoms contained more K_2O than S. 288 on the 8th day.

(2) Samples were collected from coffee plants of Kents, S. 288, S. 333, S. 795, robusta and tree coffee, from spikes to blossom and average fresh weight of buds, moisture, ash, organic carbon, total P_2O_5 , total K_2O and total nitrogen were determined. The results are given in Appendix LI (b).

Total nitrogen.—It may be seen from the table that total nitrogen uptake in the case of S. 288 is fairly uniform and decreases gradually till the 6th day and increases on the 7th day when the blossom opened. In the case of tree coffee although there is a regular decrease from spike to blossom there is a slight rise on the day previous to blossom and then a fall. Kents and S. 795 follow similar paths while showing almost daily variations. S. 333 also shows variations in nitrogen content daily but not so great as in the case of Kents and S. 795. The behaviour of robusta is most peculiar: there is first a fall, then a steep rise followed by a more gentle rise, a steep fall and then a less steep fall ending up in nitrogen content very much below that of the spike. All the blossoms with the exception of S. 333 registered lower values for total nitrogen percentage on the final day than on the first day.

Organic carbon.—Organic carbon content increases from spikes to blossom in the case of S. 288, S. 795 and tree coffee (*Coffea excelsa*) whilst in the case of Kents, S. 333 and robusta it decreases.

Total P_2O_5 : Total P_2O_5 content increases from spikes to blossom in the case of Kents, and tree coffee while it decreases in the case of the selections.

Total K_2O : Total K_2O content increases from spikes to blossom in the case of Kents, S. 333 and tree coffee whilst it decreases in the case of S. 288 and S. 795.

Average fresh weight of buds.—The average fresh weight of a single bud on day of blossom was highest in the case of S. 333 (195 mgm.) and lowest in the case of Kents (75 mgm.), the weight of the rest being tree coffee 155 mgm., S. 795 113.6 mgm. and S. 288 107.6 mgm.

Dry matter.—The percentage of dry matter in the buds decreased as the buds developed, the ranges being Kents 33.63–20%, S. 288 25.65–14.28%, S. 333 22.59–12.30%, S. 795 27.36–15.99%, robusta 26.5–16.97% and tree coffee 26.5–19.44%.

Ash content.—A general increase in the ash content was noticed in all cases, the highest increase being 14.8% in S. 333 and the lowest 4.9% in the case of tree coffee.

Moisture.—Moisture content increased in all the cases as spikes advanced to blossom. The increase is highest in the case of Kents (13.63%) and lowest in the

case of tree coffee (7.08%). With S. 288 it is 11.37%, S. 333 10.29%, S. 795 11.37% and robusta, 9.53%.

It would appear from the above as though Kents would require more moisture than the selections for opening of blossoms. The arabicas require more moisture than robusta and robusta more than tree coffee, for the development of spikes to blossoms.

(d) Studies on the Elimination of 'Fruity Flavour' of Coffee by Storage

Under instructions from the Research Committee of the Board samples of coffee as under were received for cup tasting, at three monthly intervals to find out whether storage in bulk eliminates fruity flavour:

- (1) Good whole crop cherry (picked as for parchment).
- (2) Cherry prepared from green fruit.
- (3) Cherry prepared from over-fermented coffee (small holders' strippings).
- (4) Cherry prepared from strippings after parchment has been made.

Coffee in bulk, representative of the four types were stored in Curing Works on the West Coast and inland. Parallel samples were sent to the Central Food Technological Research Institute, Mysore, for investigations. All the samples of the first set had pronounced fruity flavour of varying degrees. A progressive decrease in fruity flavour was noticed in the subsequent sets of samples received. The study has been concluded.

Advisory

Twenty-five soil samples were received from the Director of Cinchona Plantations, West Bengal. These are being analysed.

The number of determinations carried out during the year was 7,567.

N. G. CHOKKANNA,
Chemist.

IV. ENTOMOLOGY

The fields of study carried out by the Division of Entomology, for the year reported, encompassed the following:—

- A. Survey on the incidence and seasonal intensity of pests attacking coffee—conducted in collaboration with the Liaison Department.
- B. Observations on the field-scale chemical control trials and analysis of data obtained from such trials laid out in the various liaison zones and from those in and around the Coffee Research Station, Balehonnur.

- C. Laboratory studies on the parasites of green bug and on certain pests of coffee that recently assumed discernible pest proportions.
- D. Collection, identification and preservation of insect specimens obtained from various sources.

A. Survey on the Incidence and Intensity of Pests

The survey comprised tracing the following:—

1. White stem borer .. *Xylotrechus quadripes* Chev.
2. Shot hole borer .. *Xyleborus morstatti* Hgdn.
3. Green bug .. *Coccus (Lecanium) viridis* Gr.
4. Red borer .. *Zeuzera coffeæ* Nietn.
5. Hairy caterpillar spp. .. *Eupterote canaraica* Moore, *E. fabia* Cram.
6. Nematodes.

Periodic surveys brought to light the gaining importance of the two hitherto considered minor pests of coffee; viz., Red borer—*Zeuzera coffeæ* Nietn. (Order—Lepidoptera, F.—Cossidæ) and Hairy caterpillars—*Eupterote canaraica* Moore and *E. fabia* Cram. (Order—Lepidoptera, F.—Eupterotidæ) in several coffee-growing areas.

Of the two aforesaid pests, sporadic outbreak of the hairy caterpillars brought considerable damage to coffee and a few species of shade plants in the following estates on the Bababudangiris:

Chikly, Bagneheddal, Sanehadlu, Kabbinahally, Balekola and Bynecool.

Damage to coffee was mainly confined to the months, December and January, after the caterpillars had defoliated their preferred shade hosts, neeli (*Bischofia javanica* N.) and nerale (*Eugenia jambolana* Linn.).

The distribution and intensity of attack of the caterpillars were found to be as follows:—

- (1) The incidence was chiefly confined to ravines that were once planted with cardamom.
- (2) A high degree of damage to coffee occurred mostly in those estates where the pest was reported to have existed in the previous year.
- (3) In thickly shaded estates or in areas under thick shade in an estate, the damage to coffee was less than that in thinly shaded ones.

As opposed to the sporadic outbreak of the hairy caterpillars, the increase in incidence of the red borer was gradual though of a wider distribution. The pest incidence appeared to be more in the low rainfall areas than in the others where rainfall was more than 80" per annum. Also, the infestation was mostly confined to plants below six years of age. Doddengudda and Kelagane Estates in th

Mudigere area reported appreciable degrees of incidence of the pest; the average figures being 2.5 and 9.0 per acre respectively.

The incidence of the white stem borer, *Xylotrechus quadripes* Chev. (Order—Coleoptera, F.—Cerambycidae) was, in general, low.

The shot hole borer, *Xyleborus morstatti* Hgdn. (Order—Coleoptera, F.—Scolytidae) was a serious pest in the Banakal and Kalasa areas of Mudigere zone. At Kalpetta and Pulneys, the infestation was sporadic but moderate in most of the cases.

The green bug, *Coccus (Lecanium) viridis* Gr. (Order—Hemiptera—Homoptera, F.—Coccidae) was reported to be severe and widespread in several estates on the eastern and inner Giris around Chickmagalur. On the Shevaroy and Pulneys several isolated pest-infested patches were noticed.

Survey on the prevalence of eelworm pests of coffee showed that these pests were no more limited in their distribution, as evidenced by soil and plant sample examinations from various coffee zones. Mention must be made of the following estates where the occurrence of these pests has been noticed:—

Belagode Estate	}	Sakalaspur
Ossoor Estate		
Hemavathi Estate		
Coovercolly Estate	}	Coorg
Yemmegundi Estate		
Coffee Research Substation, Chethalli		
Wolligooly Estate		
Cottanad Estate	..	Wynaad
Sekhara Estate	..	Pulneys

A detailed survey of the several zones is proposed.

B. Field Trials on the Chemical Control of Pests of Coffee

1. White Stem Borer—*Xylotrechus quadripes* Chev.

Due to the low degree of incidence of the species in most of the areas where the trials are being conducted, the figures obtained have, in general, been too low.

Experiment I. Comparative Trials with B.H.C., Dieldrin and Chlordane Loc. Shigode Estate, Balehonnur—Started, October 1955

From the data obtained so far, the treatments are not statistically significant—*vide* Appendix LII. However, when numerically interpreted, it is seen that Dieldrex '18 emulsion at 0.25% (a.c.) gave maximum control of the pest when applied twice a year. Dieldrex '18 at 0.125% (a.c.)—3 applications—and Dieldrin 50% W.P. at 0.25% (a.c.)—3 applications—and B.H.C. 50% W.P. at 1.0% (a.c.)—3 applications—per year, came next in order.

The experiment is being continued.

Experiment II. Efficacy of Chlordane, B.H.C. and Dieldrin Formulations
Loc. Coffee Research Substation, Chethalli—Started, April 1955

The experiment is in progress. Data obtained for the periods 1955–56 and 1956–57 show that B.H.C. at 1.0% applied thrice and Dieldrex '18 emulsion at 0.125% applied twice a year gave consistently satisfactory results (*vide* Appendix LIII).

Experiment III

(a) *Trials with Heptachlor and Gusathion—Loc. Liaison zones—Started, May–November 1956.*

Trials with Heptachlor 25% W.P. at 0.1% (a.c.)—2 applications—and Gusathion emulsion 0.1% (a.c.)—2 applications—per year were in progress in 15 estates distributed in the various liaison zones. Other chemicals in the trials included B.H.C. 50% W.P. at 1.0%—2 and 3 applications—and Dieldrin 50% W.P. at 0.125%—2 applications—per year.

Results show that B.H.C. 50% W.P. at 1.0% applied twice and Dieldrin 50% W.P. at 0.125% applied twice per year exercised maximum control on borer incidence and they maintained this trend more consistently than Heptachlor and Gusathion, each applied twice per year, and B.H.C. applied thrice per year (*vide* Appendix LIV).

(b) *Trials on the use of 'Shell Sticker' along with B.H.C., Dieldrin, Heptachlor and Gusathion—Loc. Kelagur Estate, Mudigere—Started, May 1956.*

The results indicate that the addition of "Shell Sticker" did not reduce pest incidence by way of prolonging the duration of toxicity of the chemicals such as B.H.C. and Heptachlor. In the case of Dieldrin and Gusathion with 'Shell Sticker', borer incidence was about twice that when these chemicals were used alone. The following table presents the percentage of infestation in each treatment.

TABLE

Effect of 'Shell Sticker' used in combination with B.H.C., Dieldrin, Heptachlor and Gusathion on the percentage of infestation of stem borer

Zone	Control %	B.H.C. 1.0% 2 applns. %	B.H.C. +Sticker 2 applns. %	Dieldrin 0.125% 2 applns. %	Dieldrin +Sticker 2 applns. %	Hepta- chlor 0.1% 2 applns. %	Hepta- chlor +Sticker 2 applns. %	Gusa- thion 0.1% 2 applns. %	Gusa- thion +Stic- ker-2 applns. %
Kelagur Estate, Mudigere ..	3.75	2.5	2.5	1.25	2.5	1.25	1.25	0	1.25

Due to the extremely low degree of borer incidence in the experimental plots many of the trials may have to be freshly started in areas where the incidence would be high enough to produce statistically comparable data. Efforts to this end are underway.

2. Green Bug—*Coccus viridis* Gr.

Experiment I. Trials with Systemic Insecticides—Ekatin and Metasystox

These trials were proposed to be laid out on the Nilgiris during the post-monsoon period 1957 or in the pre-monsoon period 1958. In both the periods, however, green bug incidence had been too low with the result that no compact area could be selected to conduct the trials. Increased activity of the entomogenous fungi and parasitic insects also limited the scope for the satisfactory conduct of the trials. These are to be carried out in the near future when the pest begins activity.

Experiment II. Spray Trials with Organic Pesticides at Yercaud and Chikmagalur

Included in these trials were the organic insecticides, Basudin, Isochlorothion, Gusathion and Folidol. The trials were planned to be started at Chikmagalur and Yercaud. At Chikmagalur, an exploratory trial with the products was carried out in Gavikhan Estate. It was reported that all the chemicals, viz., Basudin (0.03% a.c.), Isochlorothion (0.05% a.c.), Gusathion (0.1% a.c.) and Folidol (0.01% a.c.) effected over 80% mortality in the bug population.

At Yercaud, the trials were not conducted due to low level in pest infestation and high degree of incidence of natural control agencies.

Fresh trials with the above products and with the newer parathion formulations—viz., Paramar-50 and Fosferno-50 and a malathion formulation are contemplated to be started in the green bug endemic areas.

Experiment III. Exploratory Spray Trials with Organic Pesticides—Loc. Coffee Research Station, Balehonnur

Potted two and a half year old *C. arabica* plants infested with green bug were selected for the experiment. The insecticides included in this trial were Basudin (0.03% a.c.), Isochlorothion (0.05% a.c.), Gusathion (0.1% a.c.), Metasystox (0.1% a.c.), Ekatin (0.02% a.c.) and Folidol (0.01% a.c.).

One plant was chosen for each chemical and on each, three pairs of leaves showing almost an uniform degree of pest infestation were sprayed with the respective chemicals soon after noting the number of bugs on the entire leaf surface. This was followed by counting of bugs on the leaves at weekly intervals for a total period of four weeks from the commencement. The method of observation on the control plant was similar to that on treated ones. Nevertheless, due to the incidence of natural parasites in the population of the bugs on the control plants, a comparison between the various chemicals and natural control is given below:—

TABLE

Percentage of mortality obtained in green bug population with the use of six different insecticides in comparison with that effected by natural control

Time Interval	Percent. mortality						
	Basu- din	Isochlo- rothion	Meta- systox	Eka- tin	Foli- dol	Gusa- thion	Natural control
1 week after ..	82.5	46.6	96.9	66.2	93.5	84.9	38.4
2 weeks ,, ..	81.4	54.6	98.8	73.3	95.7	98.5	83.6
3 weeks ,, ..	95.5	78.8	100.0	87.5	100.0	100.0	97.8
4 weeks ,, ..	98.9	84.7	..	95.0	..	..	99.4

It may be seen that Metasystox, Folidol and Gusathion effected 100% mortality in the pest population by the third week after treatment while Basudin, Ekatin and Isochlorothion came next in the series with 98.9, 95.0 and 87.7% mortalities respectively. Control effected by natural agencies, although slow to start with as observations one week after the initiation of the trial showed, however, kept a faster pace than that effected by the latter three chemicals. Thus, natural control came next to the former three chemicals in terms of per cent. mortality inflicted in the bug population.

Extended trials with the above products along with Paramar-50, Fosferno-50 and malathion are to be started when the pest again becomes active at the Research Station.

3. Shot Hole Borer—*Xyleborus morstatti* Hgdn.

Experiment I. Spray Trials with Chlorinated Hydrocarbons—Loc. Coffee Research Station, Balehonnur—Started, October 1957

Repeated trials with B.H.C. (1.0% a.c.), Heptachlor (0.1% a.c.) and Dieldrin (0.125% a.c.) did not indicate the superiority of the chemicals over control in reducing pest incidence.

TABLE

Effect of organic insecticides on Shot hole borer incidence

Treatments	Oct. 1957	Nov. 1957	Dec. 1957	Jan. 1958	Feb. 1958	Mar. 1958	Apr. 1958	May 1958	June 1958	July 1958
Incidence (%)										
1. Heptachlor 0.1%	1.6	1.4	0.8	2.4	1.0	1.2	0.6	1.4	0.8	0.6
2. B.H.C. 1.0%	1.4	0.6	0.4	1.2	0.8	1.4	0.4	0.6	1.2	1.2
3. Control	3.8	2.6	1.4	2.6	2.4	2.4	1.0	2.0	1.6	1.4
4. Dieldrin 0.125%	3.8	1.2	1.6	0.6	2.6	1.0	1.6	0.4	1.2	2.2

It is seen from the table that there had been a general trend towards decrease in pest incidence in all plants under trial. During the first two months following treatments, when the chemicals are expected to exercise maximum control, the percent. reduction in pest incidence in each is as follows: Heptachlor—50%, B.H.C.—71·4%, Control—63·1% and Dieldrin—57·8%. It is apparent that B.H.C. gave the maximum protection from borer incidence.

Experiment II. Trials with Systemic Insecticides—Metasystox and Ekatin—Loc. Coffee Research Station, Balehonnur

The trials were conducted on (a) mature *C. robusta* plants in the field and (b) potted, three-year old plants in the nursery.

(a) *Field trials*.—Each of the insecticides at the concentrations, 3% and 5% (a.c.) was applied to the plants by the 'banding method'. Shot hole borer incidence was recorded once prior to treatments (October 1957) and at monthly intervals thereafter for a period of eight months. The data indicated that none of the chemicals could appreciably reduce pest incidence. It also seems improbable that the applications of the chemicals as above could ever be a practicable method to control shot hole borer in the field.

The experiment is discontinued.

(b) *Pot trials*.—A second series of trials with Metasystox and Ekatin at 1·0, 2·0 and 5·0% strengths was undertaken.

Each concentration of the chemical was banded to four plants of which two had their surfaces of application scraped and other two, unscraped. The first batch of borers (25 in each batch) was released on to a twig, under enclosure, ten days after treatment. This was followed by observations at three-day intervals, for evidences of infestation and release of fresh batch (second release) of borers on another twig on the same plant. Thus, each plant, scraped, unscraped or control, received two releases while subsequently, two more releases were made on the remaining plant of the kind. For each release, four observations were carried out,

The data obtained were very conflicting due to the fact that establishment of the pest on the treated as well as on the control plants had been, in most cases, unsuccessful.

The experiment is planned to be repeated in the coming season of 1958.

4. Eelworms

Experiment I. Trials with Soil Amendments With and Without Sulphur—Loc. Yemmegundi Estate, South Coorg—Started, November 1956

The experiment has for its objective the examination and comparison of the use of sulphur alone and in combination with the soil amendments, calcium cyanamide and urea, in the control of coffee eelworms.

Number of parasitic eelworms in the soil samples collected periodically at different depths, viz., 0–9", 9–18", 18–27" and 27–36", for the duration—November 1956 (initial) to March 1958—had been estimated. Statistical interpretation of the data in Appendix LV is as follows:—

(1) Treatments with sulphur alone or in combination with calcium cyanamide and urea did not significantly reduce the number of eelworms in soil.

(2) The depths 0–9" and 9–18" showed significantly higher counts as compared with others while there was no significance between them.

Depths	..	0–9"	9–18"	18–27"	27–36"
Eelworms	..	146·8	153·8	84·8	65·2

(3) The months were highly significant. November 1957 showed significantly high counts while there was not much of significance in the case of other months.

Nov. 1957	April 1957	Nov. 1956	Dec. 1956	June 1957	March 1958	Sept. 1957
256·6	48·8	40·8	35·4	27·8	23·6	17·6

(4) Eelworm counts for control (A) and treatment (B)—calcium cyanamide, urea and wet. sulphur—were more significant than those for treatment (C)—normal dose of manure, 60 : 30 : 40 + wet. Sulphur—and (D)—normal dose of manure + Sulphur.

Experiment II. Trials with V.C. 13, Nemacide—Loc. Coovercolly Estate, Coorg—Started, November 1956

Data on the number of eelworms estimated in the soil samples collected periodically at four depths, viz., 0–9", 9–18", 18–27" and 27–36" for the duration—November 1956 (initial) to March 1958—have been statistically analysed. The data presented in Appendix LVI show that:—

(1) Control plots (B) showed significantly higher counts than treated plots (A)

B	A
53·9	30·7

(2) The first three months following treatment showed significantly more counts than those in March 1958.

Nov. 1956	Jan. 1957	May 1957	March 1958
36·9	20·5	25·9	1·3

its than the depth 27-36"
in the other depths.

27-36"

15.6

overcolly Estate—Started,

arabica plants. Observa-
tion of eelworms. During
died. Apparently, this
in the number of eelworms

Belagode Estates, Sakalas-

of the population data
in 1957, indicated a trend
. This trend was, how-
ever, so far there was no per-
centage in the treated plots at
least at definite conclusions

ments, V.C. 13 Nematicide,
which started at Wolligooly
since the aforesaid experi-

ing

are collected from para-

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(Please acknowledge receipt)

- F. Aphelinidæ .. *Coccophagus bogoriensis* Köening.
Coccophagus sp.
Marietta javensis How.
- F. Encyrtidæ .. *Anicetus ceylonensis* How.
Anicetus sp.
Cheiloneuromyia javensis (Grlt.)
Cheiloneurus sp.

Of the above, *Cheiloneuromyia javensis* (Grlt.) was abundant during October-November 1957. This species was chosen for study.

Studies on Cheiloneuromyia javensis (Grlt.)

The species was found to be solitary as well as gregarious during its development within the green bug host. The maximum number of individuals observed developing in a single host was four although two individuals used to be the most common. The number of emergents was often two and rarely four. The progeny emerged, consisted of a majority of females than males. The parasite species took 15-20 days to complete its life-history wherein 8-10 days were spent as egg and larva and 7-10 days as pupa.

It is hoped to study further the host relationships of this parasite species.

2. Studies on the Hairy Caterpillar—*Eupterote canaraica* Moore

O. Lepidoptera

F. Eupterotidae

The recent outbreak of this species in various estates on the Bababudangiris necessitated the study of its habits and ecological relationships. To this end, caterpillars were collected and were reared in the laboratory. Preliminary observations are as follows:—

In the laboratory, the larval period, from the date of collection of larva (possibly the second instar) to the commencement of pupal period ranged from 78 to 136 days. The pupal period ranged from 136 to 170 days. The total number of larval instars was not consistent in the different cases observed. The total duration taken for the larval and pupal periods was almost similar for males and females.

Unmated moths began egg-laying 12 hours after emergence. A female was found capable of laying 200-250 eggs in her life-time which, in the laboratory, lasted 2-4 days. Since simultaneously emerged sexes were not available, it was not possible to critically study whether the presence of either sexes together would induce courtship and mating prior to egg-laying. Trials were however conducted to study the above phenomenon by keeping together males and females emerged at different periods. In this latter case also, no mating was observed during the daytime.

When and under what conditions mating and egg-laying take place in nature remains to be studied. It is also unknown whether the females have the habit of laying eggs prior to mating in out door conditions as well.

Along with the laboratory studies, a programme to record and study the periodicity and intensity of incidence of the pest species in the field has been drawn up. These studies ultimately have for their objective the evolving of suitable measures to control the pest species.

3. Studies on the Leaf-eating Caterpillar—*Euproctis howra* Moore

O. Lepidoptera

F. Lymantriidae

This species was found defoliating *C. arabica* and *C. robusta*, during March 1958, at the Coffee Research Station.

The moths were collected and reared in the laboratory to study the life-history. The duration of each stage is given below:—

TABLE

Duration of life-history stages—Euproctis howra

Stage		Range days	Average duration days	Average temperature for the period °C.	Average relative humidity for the period %
Egg	..	6- 8	7.2	26.6	48.0
Larva	..	52-85	68.5	26.7	64.53
Pupa	..	13-19	14.6	26.9	75.30
Adult	..	6- 8	6.75	25.7	76.00

There were seven larval instars. The dark brown larvæ, provided with conspicuous tufts, were gregarious at times. They fed voraciously on cut leaves of either coffee species, *arabica* or *robusta*.

Pupation took place in a silken web spun by the larva. Cannibalism among larvæ was common at the period just prior to pupation. Often these free larvæ preyed upon the others that had transformed into pupæ.

Females began egg-laying a day after emergence. The pale yellow eggs were laid in masses and were covered with pale brown hairs. The average number of eggs that a female laid during her life-time was 125.

4. Studies on Eelworms Attacking Coffee

Of the various species of eelworms detected to attack coffee—*C. arabica*—the following ectoparasitic ones were predominant:—

- ‘Burrowing Nematode’ .. *Radopholus similis* (Cobb. 1893), Thorne (1949)
 Synonyms .. *Tylenchus similis* Cobb. (1893)
 Trylenchus biformis Cobb. (1907)
 Anguillulina similis (Cobb, 1883), Goodey, 1932
 Rotylenchus similis (Cobb., 1893), Filipjev, 1936.

‘Stylet Nematode’ .. *Tylenchorhynchus* sp.
 ‘Dagger Nematode’ .. *Xiphinema insignis* Loos. (1949)

Periodic examination of soil samples and plant material collected from suspected eelworm affected localities brought to light the pattern of distribution of the species as reproduced below:—

TABLE

Distribution of species of plant parasitic and non-parasitic eelworms in various coffee-growing estates

Eelworms Estates		<i>Radopholus similis</i>	<i>Tylencho- rhynchus</i> sp.	<i>Xiphinema insignis</i>	<i>Pratylenchus pratensis</i>	Non- parasites
Belagode	..	Yes	Yes	Nil	Nil	Yes
Ossoor	..	Yes	Yes	Yes	Nil	Yes
Hemavathi	..	Yes	Yes	Nil	Nil	Yes
Coovercolly	..	Yes	Yes	Nil	Nil	Yes
Wolligooly	..	Yes	Yes	Nil	Yes	Yes
Yemmegundi	..	Yes	Yes	Nil	Nil	Yes
C.R.S.S., Chethalli		Yes ?	Nil	Nil	Nil	Yes
Cottanad, Kelpetta		Yes	Yes	Nil	Nil	Yes
Sekhara, Manalur Pulneys	..	Yes	Nil	Nil	Nil	Yes

It is seen that *Radopholus similis* and *Tylenchorhynchus* sp. are more widely distributed than *Xiphinema insignis* and *Pratylenchus pratensis*. Non-parasites are abundant in all estates. Of the estates mentioned above, Ossoor and Wolligooly displayed the maximum number of species of parasitic eelworms.

Further to the above observations, techniques have been perfected to preserve as slide mounts representative specimens of eelworms that are being collected from time to time.

D. Insects Collected, Identified and Preserved

The following specimens of insects were collected from various sources. They have been indented and preserved:—

Order	Family	Genus and Species	Source
Coleoptera	.. Anthribidæ	<i>Aræcerus</i> sp. n. det.	Mangalore—attacking <i>C. arabica</i> monsooned, 1956-57 crop from West Coast
„	.. Scarabæidæ	<i>Serica pruinosa</i> Burm. <i>Serica</i> sp.	Pulneys, defoliating <i>C. arabica</i>
„	.. Cerambycidæ	<i>Xylotrechus smei</i> L. et G.	Sakalaspur
„	.. Tenebrionidæ	<i>Gonocephalum</i> sp.	Oothu Estate, Kalladakurichi. Breeding among mulch in nurseries
„	.. Scolytidæ	<i>Xyleborus</i> sp.	Kallalakunda Estate, Sakalaspur. On dadaps.
Hymenoptera	.. Braconidæ	<i>Apanteles obliquæ</i> Wlkn.	Parasite of lepidopterous defoliater <i>Tiracola plagiata</i> Walk. (F. Phalænidæ) C.R.S.
„		<i>A. tiracholæ</i> Ashm.	Parasite of <i>T. plagiata</i> Walk. C.R.S.
„	Ichneumonidæ	<i>Mesochorus</i> sp.	Secondary parasite on <i>A. obliquæ</i> and <i>A. tiracholæ</i> C.R.S.
„	Ceraphronidæ (Calliceratidæ)	<i>Ceraphron manilæ</i> Ashm.	Emerged from Cocoons of <i>Mesochorus</i> sp. C.R.S.
Lepidoptera	.. Eupterotidæ	<i>Eupterote canaraica</i> Moore, <i>E. fabia</i> Cram.	On coffee C.R.S.
	Lymantriidæ	<i>Euproctis howra</i> Moore	On coffee C.R.S.
	Limacodidæ	Gen. et sp. not det.	On coffee C.R.S.

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V. MYCOLOGY

Studies on the life-histories of the common diseases affecting coffee, their incidence and periodicity and their effective control were attempted. Field tests with a number of proprietary fungicidal formulations and standard Bordeaux mixture to find out their comparative efficacy were continued.

Fundamental work, particularly on the causative agencies of nursery and post-nursery diseases, viz., determination of factors influencing their incidence and spread, attempts at artificial reproduction of the diseases and possibilities of their control through fungicidal treatments as well as controlled field cultural practices were also continued.

As part of the advisory work of the division, diseased specimens collected and received from various estates were examined and necessary remedial measures

suggested. The field survey of the incidence, periodicity and influence of seasonal conditions on the major diseases both at the two Research Stations and the several coffee zones was kept up. Based on information collected from the above survey advisory and warning notes to planters to take up timely and effective protective operations were issued.

Field Trials

A. Spray Trials against Leaf Disease Caused by *Hemileia vastatrix* B. Br.

1. Experiment to find out the Efficacy of Adding Detergents, Wetters, Spreaders and Adhesives to Bordeaux Mixture

This experiment, started in May 1954, was continued. Spray application with different fungicidal formulations was given during September 1957. Details of yield and observations on leaf retention in the different treatments, recorded from the start of the trial are summarised in Appendix LVII.

No significant differences between treatments are noticed in 1957-58 yield and February 1958 leaf counts; however, in September 1957 counts, treatments G, F, H and A are significantly superior to D. Reviewing the results from the start of the trial, it is noticed that in all the three years, no significant differences in yield between the treatments are noticed. Out of eight observations on leaf retention recorded, in four cases no significant differences were noticed. In the rest of the four cases where significance was observed, except in February 1957 observation, addition of wetters, spreaders and detergents to Bordeaux mixture has not shown any significant improvement. It would appear from the foregoing that the addition of wetters, spreaders, detergents, etc., to Bordeaux mixture has not given any consistent and significant improvement in the matter of leaf disease control. The experiment is concluded and discontinued.

2. Comparative Trials Using Bordeaux Mixture and Proprietary Fungicides

(a) *Experiment to compare the efficacy of proprietary copper fungicides with that of Bordeaux mixture.*—This trial started in May 1953 was continued. Post-monsoon spray application with the different fungicidal formulations was given during September 1957. The details of yield and observations on leaf retention recorded from the start of trial are furnished in Appendix LVIII.

In 1957-58 yield, Bordeaux mixture was found to be significantly superior to Cupravit. Both in September 1957 and February 1958 leaf counts, no significant differences were noticed. Reviewing the results from the start of trial, it is noticed that except in 1957-58 where Bordeaux mixture was found to be superior to Cupravit, no significant differences in yield were noticed between the treatments. With regard to effective percentage of leaf survival, out of a total of nine observations, no significant differences are noticed in five cases. In the remaining four cases, either Bordeaux mixture is superior or *on par* with one or the other of the proprietary fungicides. The experiment has been concluded.

(b) *Experiment to compare the efficacy of proprietary fungicides with Bordeaux mixture.*—This experiment started in September 1954 was continued. Spray applications were given as per schedule. The details of yield and leaf counts recorded from the start of trial are summarised in Appendix LIX.

Bordeaux mixture has given significantly superior yield over Shell Copper fungicide and Dithane Z-78 during 1957–58. In September 1957 leaf counts, treatment A (Bordeaux mixture) is superior to treatments B and D (Perenox and Shell Copper fungicide). In February 1958 counts, however, no significant differences are noticed. The yield data during the three years the trial has been in progress show that Bordeaux mixture is superior to one or other of the proprietary fungicides, none of the latter being superior to Bordeaux mixture—at best being *on par* with Bordeaux mixture. With regard to leaf retention also the same trends are noticed. The trial is concluded and discontinued.

(c) *Experiment to compare the efficacy of Blitox Ipsilon with Bordeaux mixture.*—This trial started in June 1956 was continued. Spray applications with the different fungicides were given in September 1957 and April 1958. Leaf counts were taken in September 1957 and February 1958. The data are summarised in Appendix LX.

Observations on leaf retention made during September 1957 show that treatment with Bordeaux mixture at 400 gallons an acre is significantly superior to treatments I, F, D, E, B and H, treatment H (Unsprayed control) showing the minimum leaf retention. In February 1958 counts, no significant differences were noticed.

3. Comparative Trials Using Bordeaux Mixture and other Proprietary Fungicides

(a) *Experiment to compare Mercurised copper oxychloride with Bordeaux mixture.*—This experiment started in September 1954 was continued. Post-monsoon spray application with the different treatments was imposed in September 1957. Observations on effective percentage of leaf survival, recorded from the start of trial, are summarised in Appendix LXI.

In September 1957 counts, treatments Bordeaux mixture and Copper Sandoz are significantly superior to different concentrations of Mercurised copper oxychloride, while in February 1958 counts no significant differences between the treatments being noticed. In three out of a total of seven observations recorded so far, the data are significant. In two of these, Bordeaux mixture is significantly superior to Mercurised copper oxychloride (in one over all the concentrations and in another over the highest concentration). In February 1955 observation, 0.2% Mercurised copper oxychloride gave significantly superior results over Bordeaux mixture. This is to be explained by the fact that the former had a much higher initial effective percentage of leaf survival at the commencement of trial and may not be due to better disease control,

It was observed that plants sprayed with Mercurised copper oxychloride showed phytotoxic symptoms, viz., curling and crinkling of leaf margins, elongation of leaf lamina and chlorosis of interveinal leaf area. This experiment has been concluded.

(b) *Experiment to compare Tuzet fungicide (an organic fungicide) with Bordeaux mixture.*—This trial started in May 1955 was continued. Post-monsoon spray application was given in September 1957. The assessment of disease incidence made in the different treatments from start of trial is furnished in the following table:—

Symbol	Treatments	Mean Percentage of diseased leaves				
		Feb. 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958
A	Bordeaux mixture 0.5% ..	30.11	69.90	64.66	82.51	54.59
B	Tuzet fungicide 0.2% ..	45.09	65.74	66.55	84.11	57.63
C	do. 0.1% ..	41.26	62.61	59.67	84.80	60.70
D	do. 0.05% ..	45.80	69.34	63.85	91.43	63.64

Bordeaux mixture has accounted for a lesser disease percent. than Tuzet treatments, both in September 1957 and February 1958 observations. Reviewing the results from the start of trial, in three out of five observations, Bordeaux mixture showed better disease control than the different concentrations of Tuzet fungicide. In the other two cases, 0.1% Tuzet fungicide was found to be better than Bordeaux mixture.

It was noticed that plants sprayed with Tuzet fungicide exhibited phytotoxicity, viz., green vein chlorosis. The experiment has been discontinued.

(c) *Experiment to compare proprietary fungicides with Bordeaux mixture.*—This trial started during 1956 pre-monsoon was continued. Post- and pre-monsoon spray applications were given as per schedule. Observations on the effective percentage of leaf survival in the different treatments are summarised in Appendix LXII.

Treatments I, H and G (Bordeaux mixture plain, Bordeaux mixture + Ortho sticker, and Bordeaux + Tenac sticker) were significantly superior to E, F and J (Flit-406, Ultra-sulphur and unsprayed control) in September 1957 observation. In February 1958 counts, treatment E (Flit-406—0.4%) was superior to Treatments G, B, F and J (plain Bordeaux, M.C.M. Copper oxychloride, Ultra-sulphur and unsprayed control). It may be mentioned here that in 1956 September and 1957 February counts also, Bordeaux mixture either alone or with sticker and Flit-406 were found to give better leaf retention than other treatments.

(d) *Experiment to compare proprietary fungicides and 2:4-D with Bordeaux mixture.*—This exploratory trial started during the post-monsoon period of 1956 was continued. Spray applications with the different formulations were given in

September 1957 and April 1958. Details of assessment of disease incidence recorded in the different treatments are furnished in the following table:—

Symbol	Treatments	Mean percentage of diseased leaves			
		Initial Nov. 1956	July 1957	Sept. 1957	July 1958
A	Kirticopper 1 lb./40 gallons ..	70·60	42·79	82·19	41·45
B	Flit-406—0·2%	61·70	58·60	88·39	39·28
C	Flit-406—0·4%	67·20	65·47	80·90	39·27
D	Bordeaux 0·5%	71·80	37·21	78·49	39·31
E	2:4-D 8 p.p.m. in water ..	68·70	66·73	90·00	64·17
F	Control—unsprayed ..	74·50	89·71	87·84	71·29

Bordeaux mixture sprayed plots showed the minimum disease incidence consistently followed by Flit-406. Unsprayed control and 2:4-D sprayed plots showed a high disease incidence throughout. Phytotoxic symptoms, viz., narrow elongated leaves with slight crinkling, were noticed in 2:4-D treated plants.

(e) *Experiment to compare new proprietary fungicides with Bordeaux mixture.*—This experiment started during May 1957 to compare the efficacy of certain new proprietary fungicides with that of standard 0·5% Bordeaux mixture in controlling leaf disease of coffee was continued. The spray applications with different formulations were given in September 1957 and April 1958. Observations on effective percentage of leaf survival and disease counts recorded in the different treatments are summarised in Appendix LXIII.

Bordeaux mixture was found to be superior to Cobredon, Cupricol and Unsprayed control, but was on a *par* with Dithane-M 22 during September 1957 counts. In February 1958 counts, Dithane-M 22 was superior to all the treatments. Observations on disease incidence also indicated that Dithane-M 22 and Bordeaux mixture gave better disease control than other treatments, the unsprayed control showing the maximum disease incidence.

4. Experiments at Coffee Research Substation, Chethalli

(a) *Comparative trial with proprietary copper fungicides and Bordeaux mixture.*—This trial started during 1953 was continued. Post-monsoon spray application was given in September 1957. The details of yield and effective percentage of leaf survival recorded are summarised in Appendix LXIV.

During 1957–58, Bordeaux gave the highest yield. In September 1957 leaf counts also, Bordeaux showed a higher leaf retention than other treatments. The yield data from the start of the trial show that Bordeaux mixture gave the highest

yields in three out of four years. With regard to leaf counts, out of a total of eight observations recorded, in four cases Bordeaux gave the highest leaf retention and in two cases came second in order. Bordeaux mixture is thus seen to be superior to the proprietary copper fungicides tested, since the former gave consistently higher yields and better leaf retention.

The trial has been concluded.

(b) *Experiment to compare new proprietary fungicides with Bordeaux mixture.*—This trial started in May 1957 was continued. Post- and pre-monsoon spray applications have been given as per schedule. Observations on the effective percentage of leaf survival and disease incidence recorded in the different treatments are furnished in Appendix LXV.

Both in September 1957 and February 1958 leaf counts, Bordeaux mixture either alone or with Tenac sticker gave higher leaf retention as compared to other treatments, the unsprayed control showing the minimum leaf retention. The assessment of disease incidence during July 1957 and July 1958 also shows the superiority of Bordeaux mixture over other fungicides under test, the former showing a lesser disease incidence than the latter.

(c) *Comparison of proprietary fungicides with Bordeaux mixture.*—This trial was started during May 1958 to find out the efficacy of certain fungicides (based on copper as well as of an organic nature) as compared with the standard 0.5% Bordeaux mixture in controlling leaf disease of coffee. The details of the trial are furnished below:—

Locality.—Coffee Research Substation, Chethalli.

Year of Start.—May 1958.

Treatments.—

- | | |
|--|-----------------------|
| (A) Cobredon at 17.6 oz. in 40 gallons water | } Two sprays an year |
| (B) Cupricol at 1 lb. in 40 gallons water | |
| (C) Parrycop-50 1 lb. in 40 gallons water | |
| (D) Dithane-M 22 at 4 lb. in 100 gallons water | |
| (E) Bordeaux 0.5% | |
| (F) Bordeaux + Triton X 114 (45 ml. in 40 gallons) | } Four sprays an year |
| (G) Dithane-M 22—at 4 lb. in 100 gallons | |
| (H) Unsprayed control | |

Replications.—5.

Lay-out.—Randomized.

Plot size.—Gross 3×3—9 plants.

Net.—Middle plant in middle row.

The experiment is in progress.

5. Spray Trials in Liaison Zones

(a) *Comparison of Blitox Ipsilon and Bordeaux mixture regarding efficacy of leaf-disease control.*—This trial started in 1956 post-monsoon was continued. Post- and pre-monsoon spray applications were given according to schedule. Observations on effective percentage of leaf survival recorded are furnished in the following table:—

Locality: Vanguard Estate, Shevaroys.

Replications: 5

Lay-out: Randomized.

Treatments: 9

Started in: 1956 post-monsoon.

Symbols	Treatments	Average effective percentage of leaf survival		
		Feb. 1957	Sept. 1957	Feb. 1958
A	Blitox Ipsilon at 5 lb./acre	89.00	46.00	48.00
B	do. 10 "	85.00	45.00	49.00
C	do. 15 "	83.00	47.00	53.00
	} At 300 gal./acre			
D	do. 5 "	83.00	43.00	49.00
E	do. 10 "	92.00	49.00	52.00
F	do. 15 "	87.00	35.00	31.00
	} At 400 gal./acre			
G	Bordeaux mixture 0.5%	92.00	48.00	52.00
H	Blitox (50% W.P.) 1 lb. in 40 gallons water	90.00	44.00	56.00
	} At 400 gal./acre			
I	Unsprayed control	77.00	38.00	44.00

It is seen from the above that neither Blitox Ipsilon in the different concentrations nor Blitox (50% W.P.) have given any consistently higher leaf retention than Bordeaux mixture.

This trial was originally laid out in Vanguard and Glenpeak Estates in Shevaroys, but the trial in the latter has been discontinued.

(b) *Time of spray trial in North-East Monsoon rainfall areas.*—This trial started in the Shevaroys during 1957 to find out a suitable time schedule for effective protective spraying against leaf disease was continued. The spray applications as per schedule were imposed.

As the trial has run only for a short period, it has not been possible to draw any definite conclusions regarding the efficacy of the different treatments; however, it was seen that all sprayed plots showed a greater leaf retention than unsprayed plots.

(c) *Anti-leaf fall spray trials.*—This trial started in 1957 in the Bababudangiris to find out the effect of spraying 2:4-D and higher concentrations of Bordeaux mixture in controlling monsoon leaf and berry shed was continued. The scheduled spray applications were given.

Observations recorded during the South-West Monsoon period of 1958 has shown the same trends as noticed in the previous year, viz., leaf and berry shed is less in plots treated with 2:4-D either in water or neutral Bordeaux mixture as compared with plots sprayed with the different concentrations of Bordeaux mixture.

General Conclusions on Spray Trials Comparing Bordeaux Mixture with Proprietary Fungicides for Control of Leaf Disease of Coffee

Twenty-four different fungicidal formulations based on copper, mercury, sulphur and of an organic nature, in different concentrations, were compared with Bordeaux mixture to find out their relative efficacy in controlling leaf disease of coffee. The results from these trials indicate that the standard 0.5% Bordeaux mixture now in common use is as good as and in some cases better than the formulations tested so far. Addition of detergents, spreaders, wetters, etc., to Bordeaux mixture has not shown any significant and consistent improvement over the plain Bordeaux mixture regarding efficacy of leaf disease control.

B. Studies on Damping off and Collar Rot of Nursery Seedlings Caused by *Rhizoctonia* sp.

Trials started earlier to find out the efficacy of partial soil sterilization before and after transplanting of seedlings in controlling collar rot were repeated for confirmation of results obtained earlier. Studies on possibilities of biological control of this disease were also started.

(a) *Comparative efficacy of various fungicides in controlling collar rot.*—(1) The following fungicides, viz., Bordeaux mixture 1%, Flit-406 0.4%, Ultra-sulphur 1 lb. in 60 gallons water, Formaldehyde 0.8%, Leytosol-b 1 in 150, Crag fungicide-974 at 50 lb. per acre and Vapam at 2 pints in 15 gallons water were applied as a soil drench to sterilize the soil in different sets of baskets before seedlings were transplanted. Formaldehyde was applied two weeks prior to transplanting; Crag fungicide-974, Vapam and Leytosol-b one week prior and the other treatments two days prior to transplanting so as to reduce chances of phytotoxicity to seedlings. After transplanting, in half the number of seedlings in each treatment, a routine soil drenching application with 1% Bordeaux mixture was given at fortnightly intervals.

Preliminary observations showed that the maximum disease incidence was in the untreated control plots. Plots initially treated with Formaldehyde or Bordeaux mixture and followed by fortnightly soil drenches with Bordeaux mixture gave a complete control of the disease. The other fungicidal treatments were less effective in controlling the disease.

(2) Different fungicides were applied as a soil drenching spray to seedlings in baskets one week after transplanting. The treatments were repeated once in 10 days and a total of five applications given. The soil in the baskets was artificially inoculated with the culture of *Rhizoctonia* sp., three days prior to start of spray

application. Observations on disease incidence recorded are furnished in the following table:—

Symbols	Treatments	Percentage of damping off				
		10 days after	20 days after	30 days after	45 days after	60 days after
A	Bordeaux mixture—0.5%	16.7	16.7	16.7	14.6	12.5
B	Bordeaux mixture—1%	16.7	12.5	12.5	12.5	12.5
C	Flit-406—0.4%	27.1	20.8	20.8	20.8	20.8
D	Dithane—M 22—0.4%	12.5	14.6	14.6	14.6	14.6
E	Blitox—1 lb. in 40 gallons water ..	25.0	25.0	22.9	18.7	14.6
F	Perenox—1 lb. in 40 gallons water ..	18.7	18.7	18.7	18.7	18.7
G	Control Inoculated	47.9	47.9	52.1	54.2	54.2
H	Control Uninoculated	Nil	Nil	Nil	Nil	Nil

No natural incidence of the disease occurred as seen from Treatment H, whereas in all other treatments where artificial introduction of the pathogen was made, disease incidence to varying degrees was noticed. Maximum disease incidence was noticed in Treatment G (Control-inoculated). A progressive increase in the disease is noticed in this case. In Treatments A to F which also were artificially inoculated but sprayed with different fungicides, some of the seedlings took infection following introduction of the pathogen. However, with repeated fungicidal applications, further increase in disease incidence was checked in these cases. Some of the seedlings showing minor infections recovered and survived. It is noticed that Bordeaux mixture treatment gave the maximum disease control.

(b) *Studies on microbial antagonism—biological control of damping off and collar rot disease.*—A few strains of *Penicillium* sp. showing antagonism to *Rhizoctonia* sp. have been isolated in pure culture. Studies have been started to investigate the possibility of utilising these strains in the biological control of damping off and collar rot disease of coffee seedlings.

C. Studies on Brown-Eye-Spot Disease Caused by *Cercospora* sp.

(a) *Trial to assess the relative susceptibility of different varieties of arabica coffee.*—This observational trial started in June 1957 to find out whether there is any difference in relative susceptibility to brown-eye-spot disease between leaf disease susceptible and resistant arabica varieties was continued. The varieties under study are Kents and S. 795. Observations on disease incidence recorded are furnished in the following table:—

Symbols	Treatments	Percentage of disease incidence						
		Oct. 1957	Nov. 1957	Dec. 1957	Jan. 1958	Feb. 1958	March 1958	April 1958
A	Kents	66.8	56.8	49.1	28.6	10.0	12.5	13.6
B	S. 795	66.1	66.0	48.1	20.2	10.4	12.0	10.0

Very little difference in relative susceptibility to brown-eye-spot disease between Kents and S. 795 is noticed. The same trend was noticed in earlier observations also.

(b) *Comparative efficacy of different fungicides in controlling brown-eye-spot disease in nursery seedlings.*—(1) This trial started in June 1957 to find out the comparative efficacy of different fungicides in controlling brown-eye-spot disease was continued. Observation on the comparative disease incidence recorded in the different treatments is furnished in the following table:—

Symbols	Treatments		Percentage of disease incidence	
A	Dithane-M 22	0.4% + Ortho sticker	Monthly application	33.57
B	Flit-406	0.4% + do.		38.20
C	Bordeaux	1% + do.		25.34
D	Bordeaux plain	1%		24.27
E	Dithane-M 22	0.4% + do.	Fortnightly applications	23.42
F	Flit-406	0.4% + do.		27.82
G	Bordeaux	1% + do.		21.60
H	Bordeaux plain	1%		20.10
I	Control—unsprayed			47.62

It is seen that the fungicidal applications effected considerable check on the disease incidence, unsprayed control showing maximum disease incidence. Of the fungicides tested Bordeaux mixture 1% gave a better disease control than Dithane-M 22 and Flit-406. In general, spray applications at fortnightly intervals were more effective than the monthly applications. Addition of sticker to Bordeaux mixture has not materially improved efficacy of disease control. In the sprayed plants, with repeated fungicidal applications, the disease was found to be kept under check, whereas in the untreated control plots, the disease went on increasing till it reached a peak during October-November. From December onwards both in treated and untreated seedlings, consequent to prevailing unfavourable weather

conditions, no further disease incidence was noticed and the fresh summer flush formed were free from the disease. Observations on the vigour and health of seedlings made in January 1958 showed that sprayed plants were more vigorous in growth with an average of three pairs of primaries whereas in the untreated control plots the plants did not have even an average of two pairs of primary branches.

(2) To confirm the results obtained above, the trial is being repeated this year with the addition of one more treatment, *viz.*, Spersul. Seedlings transplanted in June 1958 have been treated with the different fungicides in July 1958. Observations are in progress.

(c) *Incidence of "Cercospora" in relation to fungicidal and nutritional treatments.*—This trial started in June 1957 was continued upto December 1957. Observations on the relative incidence of the disease in the different treatments are furnished below:—

Symbols	Treatments	Percentage disease incidence	Remarks
A	Urea 1% foliar spray at 1 gal./300 seedlings ..	53.98	
B	Urea + 1% Bordeaux foliar spray at 1 gal./300 seedlings	27.81	Phytotoxic symptoms noticed
C	Urea + 1% Bordeaux foliar spray at 1 gal./300 seedlings	24.02	
D	Urea 0.2% soil application 5 gal./300 seedlings ..	40.97	
E	Urea watering through leaf top and covering the soil	42.36	
F	Urea 0.5% spray + 0.1% urea soil application ..	52.22	
G	Urea 0.5% + 1 Bordeaux spray + 0.1% urea soil application	27.51	Phytotoxic symptoms noticed
H	Control—Untreated	42.15	

It is seen from the above table that wherever Bordeaux mixture is given either alone or in combination with urea as a foliar spray considerable check on the disease resulted. Addition of fertilizer grade urea to Bordeaux mixture has resulted in phytotoxic symptoms. Addition of urea to Bordeaux mixture did not increase the efficacy of disease control. In unsprayed control and where urea alone is applied, the disease incidence is high. Observations on the general vigour and health of the seedlings showed that Bordeaux treated ones were the best. Seedlings under other treatments remained stunted and weak due to high disease incidence and/or phytotoxicity.

D. Project on Nursery and Post-Nursery Diseases

Diseases of seedlings in nurseries and young plants in clearings like damping off and collar rot, brown-eye-spot disease, etc., which used to be of a very minor nature, have been gaining importance in the past few years. Apart from the above diseases already in existence, certain new types of maladies like "Kondlie disease", "dry collar rot" and "stem canker" have also been noticed recently and are causing concern. To investigate into the causes of these maladies as well as to find out suitable remedial measures, a project was started towards end of July 1957.

A preliminary survey with reference to incidence, intensity and periodicity of these maladies has been in progress, particularly in Sakalasapur, Mudigere and Balehonnur coffee areas, where these maladies seem to be more concentrated. From the survey, the following maladies were found responsible either in complete mortality of the affected plants or cause considerable loss of vigour and health:—damping off and collar rot, brown-eye-spot, kondlie, dry collar rot and stem canker.

(1) *Damping off and collar rot*.—This disease was found affecting seedlings in nurseries both in the primary germination bed as well as after transplanting to secondary beds or baskets, more often in the earlier stages. Affected seedlings show discoloration and rotting at the collar region, invariably followed by the death of the affected seedlings. The disease was found to be caused by the fungus *Rhizoctonia* sp. This disease is more prevalent in nurseries kept in an unsanitary condition, want of proper drainage in the soil resulting in over-moist soil conditions, over-crowding of seedlings, lack of proper ventilation and lighting due to thick overhead pandal, etc. The disease was found to be of rather widespread occurrence having been noticed in all the coffee areas. Critical studies at the Coffee Research Station, Balehonnur, have shown that maintenance of clean sanitary conditions in the nursery along with a routine soil drenching application at monthly intervals with 0.5% Bordeaux mixture gives considerable control of the disease.

(2) *Brown-eye-spot disease*.—This disease usually causes leaf-spots leading on to defoliation. Die-back of lateral branches as well as the growing tips are noticed in serious cases. Occasionally tender stems of young plants and berries are also affected. The intensity of infection and accompanying damaging effects are more pronounced on young coffee up to three years. On older coffee though the disease may be noticed, no appreciable damage usually results.

The disease is caused by *Cercospora* spp. Indications are that *Cercospora coffeicola* and *C. coffeæ* are responsible for this disease. The disease is fairly widespread in Sakalasapur, Mudigere, Aldur, Balehonnur coffee areas, and is of a minor nature on the Shevaroyis, Nilgiris, Pulneys, Coorg and Bababudangiris.

Field observations have shown that the pathogen is active during the rainy weather months—April to November. During the dry weather months December to March the pathogen is usually inactive. With the advent of favourable warm humid conditions following the first summer showers in March-April, the fungus starts activity and spread of the disease follows in the months of May and June.

Very often a high incidence is noticed during July followed by heavy shed of diseased leaves. As the South-West Monsoon tails off and North-East sets in, ideal conditions for disease incidence and spread are obtained. Invariably a second peak incidence is noticed during October-November. From December onwards very little spread of the disease is seen. It has been often noticed that plants under exposed conditions usually suffer more from the disease.

Most of the coffee species and varieties are susceptible to this disease. All the commercially cultivated arabica coffee in South India are found to be affected by this disease. Leaf disease susceptible and resistant varieties of arabica are both found to be highly susceptible to the disease.

Judicious spraying with 1% Bordeaux mixture at fortnightly to monthly intervals from the time the seedlings are transplanted from germination beds till October-November gave a satisfactory control of the disease.

(3) *Kondlie disease*.—This disease is found affecting seedlings in nurseries during the period August–November. Affected seedlings show malformation of the stem, a constriction usually at the first node from ground level, the stem immediately above being bulged or flattened. Affected seedlings which escape detection in the nursery, after transplanting to field, during October–November, snap off at the constricted region and usually die off. This disease has been noticed in a number of estates in Sakalaspur and Balehonnur areas. A few estates in Coorg area have also reported this trouble.

Though a fungus belonging to the genus *Chætophoma* (?) and a bacterium have been invariably found associated with the diseased tissues as well as isolated from diseased tissues in artificial culture, the part played by these two organisms in causation of the disease is not yet known. Attempts at artificial reproduction of the disease using the above micro-organisms have been unsuccessful.

Spraying the seedlings with 0.3% Flit-406, tried in a number of cases, have been found to check the disease incidence and spread. Spraying of Bordeaux mixture has not been successful in controlling the disease.

Further investigations on the causative agency, attempts at artificial reproduction of the disease and an effective control of the disease, are in progress.

(4) *Dry collar rot*.—This malady was found affecting young plants in clearings 12 to 15 months old. Affected plants show drying up of stem usually 2 to 3 inches above soil level, the stem portion immediately above and below the affected area remaining green in the initial stages of infection. Such plants wilt and finally die. The first visible external symptoms of distress, *i.e.*, wilting of leaves is usually noticed following first summer showers in March–April. This type of malady was reported from a few estates in Sakalaspur area during 1957–58.

Observations so far made indicate that this malady is prone to be more serious under exposed conditions. Clearings which have resorted to partial retention of original jungle during clearing, heavy mulching, protection of seedlings

during hot weather with shade, artificial irrigation, etc., have been found to be free from this trouble usually.

Examination of affected tissues has shown the presence of the following fungi—*Fusarium* sp. and *Rhizoctonia* sp. Artificial inoculations with the above fungi have not been successful in reproducing the disease symptoms.

Attempts at reproduction of the disease artificially are being repeated. Assessment of the influence of seasonal, climatic and cultural conditions on the incidence of the disease is also in progress.

(5) *Stem canker*.—This malady was noticed on young plants, 12 to 15 months old in clearings. Affected plants showed canker-like depressions and ring barking with irregular margins on the stem at various levels (collar region, stem higher up, suckers and primary branches). Visible external symptoms are usually noticed during the period April—June. A few estates in Sakalaspur, Mudigere, Balehonnur, Coorg and Biligiris have reported this trouble.

The survival of the affected plants in the field depends mainly on the depth to which the wound has penetrated. In cases where the wound was only superficial, the plants survived following callusing at the injured portions, whereas in those cases with deep and complete ringing the plants wilted and died.

Examination of the affected portions showed that in initial stages the ringed areas including the margins remained green. In such cases no parasitic micro-organisms could be detected. In cases of fairly advanced ringed areas, the tissues were usually darkened and a number of saprophytic and wound parasitic fungi were found. The exact cause of this malady is still unknown.

E. Studies on Target Leaf-Spot Disease of Coffee Caused by *Myrothecium advena* Sacc.

A new leaf-spot disease of arabica coffee was noticed recently in a few plantations in and around Balehonnur and Sakalaspur area. Seedlings in nurseries and mature coffee with densely growing low hanging branches have been found to be affected by this disease.

The disease is seen mostly on the leaves, rarely tender stems and fruits are attacked. On the leaves, large brown circular to irregular spots are formed. Concentric zonation visible on the upper surface of the spots gives a characteristic "target board" appearance. On the under-surface, black fruiting bodies with white margins are seen developing. Severe infection leads on to defoliation. The disease has been observed so far only on arabica coffee.

The morphology of the causative agency has been studied in detail. The fungus causing this disease has been identified as *Myrothecium advena* Sacc. The same malady has been reported earlier from France on fading coffee leaves. The specific epithet *advena* given by the original author indicates the adventitious appearance of the fungus on the host. Preliminary pathogenicity trials conducted

at Coffee Research Station, Balehonnur, have shown that the fungus is an active parasite capable of reproducing the characteristic symptoms on arabica coffee. This new disease recorded in South India seems to be the first record of *Myrothecium advena* as an active parasite of arabica coffee.

Field observations have indicated that the disease has not attained any major status.

K. V. GEORGE,
Mycologist.

APPENDIX I

Statement showing the Sanctioned Strength and Actual Number Working
as on 31st July, 1958

Sl. No.	Category/Scale of Pay	Research & Extension		Development	
		Sanctioned strength	Actual working	Sanctioned strength	Actual working
1	Class I				
	Director of Research	1	1	..	..
2	Class II				
	(a) Rs. 275-800				
	Chemist	1	1	..	..
	Botanist	1	1	..	..
	Agronomist	1	1	..	..
	Mycologist	1	1	..	..
	Entomologist	1	1	..	..
	Senior Liaison Officers ..	3	3	1	1
	(b) Rs. 250-500				
	Assistant Chemist	1	Nil	..	..
	Assistant Botanist	1	1	..	..
	Assistant Mycologist	1	..	(Post held in abeyance)	
	Special Officer, Plant Protection	1	Nil		
	Secretary to Director of Research	1	1		
	Superintendent, Coffee Research Substation, and Coffee Research Station	2	1	(The post at C.R.S. held in abeyance)	
	Junior Liaison Officers ..	12	9	..	..
3	Class III				
	(a) Rs. 160-10-330				
	Research Assistants	9	7	4	2
	Farm Assistant	1	1	..	..
	Liaison Assistants	..	..	16	5
	Statistical Assistant	..	..	1	1
	(b) Rs. 100-5-150-10-250				
	Junior Scientific Assistant ..	4	1	..	..
	(c) Rs. 100-5-125-6-185-E.B.-8-225				
	Mechanic	1	1	..	..
	(d) Fieldmen—Rs. 60-130 ..	50	31	14	8
	(e) Fitter—Rs. 60-5/2-75-3-105 ..	1	1	..	..
	(f) Compounder—Rs. 60-5/2-75-3-105	1	1	..	..
	(g) Head Clerks—Rs. 100-250 ..	4	3	..	..
	(h) Senior Clerks—Rs. 80-220 ..	5	5	..	..
	(i) Camp Clerk—Rs. 80-220 ..	1	1	..	..
	(j) Stenographer—Rs. 80-220 ..	1	1	..	..
	(k) Junior Clerks—Rs. 60-130 ..	14	14	11	11
	(l) Typists—Rs. 60-130	2	2	..	..
4	Class IV				
	(a) Drivers—Rs. 40-2-60	6	6	1	1
	(b) Laby. Attenders—Rs. 30- $\frac{1}{2}$ -35 ..	7	7	..	..
	(c) Mechanical Attenders Rs. 30- $\frac{1}{2}$ -35	2	2	..	..
	(d) T.B. Attenders—Rs. 30- $\frac{1}{2}$ -35 ..	3	3	..	..
	(e) Peons—Rs. 30- $\frac{1}{2}$ -35	22	19	1	1
	TOTAL	162	127	49	30

APPENDIX II

*Statement showing the Supply of Seed Coffee of Station Selections
from 1948-49 to 1957-58*

Year	Arabica Station Selections Lb.	Kents Arabica Lb.	Robusta S. 274 Lb.	Robusta Lb.	Excelsa Liberica Lb.	Total Lb.	Number of planters to whom seed was distributed
1948-49 ..	150	262	62	759	2	1,235	164
1949-50 ..	253	173	47	506	..	979	168
1950-51 ..	400	366	40	1,046	1	1,853	237
1951-52 ..	695	80	45	1,139	..	1,959	228
1952-53 ..	888	45	35	875	9	1,852	310
1953-54 ..	1,456	20	106	720	31	2,333	500
1954-55 ..	5,421	..	77	800	39	6,337	1,247
1955-56 ..	10,669	..	189	1,164	27	12,049	1,693
1956-57 ..	13,397	..	45	296	26	13,764	2,034
1957-58 ..	13,504	..	34	780	14	14,332	2,529
TOTAL ..	46,833	946	680	8,085	149	56,693	9,110

APPENDIX III

*Statement showing the Distribution of Seed Coffee Liaison District-War
for the past Three Years*

Sl. No.	Name of the Liaison District	Year—1955-56		Year—1956-57		Year—1957-58	
		Arabica	Robusta	Arabica	Robusta	Arabica	Robusta
		Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
1	Chikmagalur ..	2,012	54	1,821	26	1,043	9
2	Mudigere ..	2,128	130	3,343	74	3,355	65
3	Sakalaspur ..	1,886	152	1,623	30	1,406	12
4	North Coorg ..	1,467	30	2,346	3	1,350	12
5	South Coorg ..	1,577	76	1,650	2	3,120	102
6	Yercaud ..	233	1	428	..	304	2
7	Kalpetta ..	755	547	1,439	82	722	220
8	Coimbatore including Pulneys, Nilgiris, Ana- mallais ..	379	302	462	128	1,906	176
9	Other areas ..	232	88	285	22	298	230
	TOTAL ..	10,669	1,380	13,397	367	13,504	828

APPENDIX IV

Statement showing the Number of Demonstration Blocks (Improvement Blocks)/
Reorientation Plots/Differential Manurial Blocks/Field Manurial Trial Plots/Varietal
Trial Plots and Plant Protection Trial Plots in the Different Liaison Zones

Sl. No.	Name of the Liaison Zone.	1956-57 (No. of plots under various trials)					
		Demonstration blocks	Reorientation plots	Differential manual trial plots	Field manual trial plots	Varietal trial plots	Plant protection trial plots
1	2	3	4	5	6	7	8
1	Chikmagalur	12	2	4	2	6	4
2	Mudigere	12	8	4	4	6	7
3	Sakalasapur	10	Nil	Nil	8	5	5
4	North Coorg	12	Nil	Nil	1	4	4
5	South Coorg	15	2	Nil	2	Nil	3
6	Kalpetta	22	Nil	Nil	6	4	1
7	Yercaud	20	5	6	1	1	6
8	Coimbatore, Nilgiris, Annamalais, Nelliampathies	1	8	Nil	1	1	2
9	Pulneys	3	6	Nil	Nil	4	Nil
10	Koppa	..	..	..	..	..	..
TOTAL ..		107	31	14	25	31	32
GRAND TOTAL ..		240					

Sl. No.	Name of the Liaison Zone	1957-58 (No. of plots under various trials)							Remarks
		Demonstration blocks	Reorientation plots	Differential manual trial plots	Field manurial trial plots	Varietal trial plots	Plant protection trial plots		
		9	10	11	12	13	14	15	
1	Chickmagalur ..	18	2	4	2	6	4		
2	Mudigere ..	15	11	4	4	6	7		
3	Sakalaspur ..	21	1	4	8	5	5		
4	North Coorg ..	9	4	..	1	4	4		
5	South Coorg ..	19	2	..	2	..	3		
6	Kalpetta ..	28	..	..	6	4	1		
7	Yercaud ..	20	5	6	1	1	6		
8	Coimbatore, Nilgiris, Anamallais Nelliampathies	14	8	4	1	1	2		
9	Pulneys ..	14	6	4	..	4	..		
10	Koppa ..	..	6	..	..	..	..		
	TOTAL ..	158	45	26	25	31	32		
	GRAND TOTAL ..		317						

APPENDIX V

Statement showing the Number of Estates receiving Loan Aids under the Development Plan, taken up for Intensive Advisory Service

Sl. No.	Name of Liaison District	Number of estates	
1	Chikmagalur	15	
2	Mudigere	12	
3	Sakalaspur	19	
4	North Coorg	21	
5	South Coorg	23	
6	Kalpetta	1	
7	Pulneys	8	
8	Yercaud	4	
9	Coimbatore	..	
	TOTAL ..	103	

APPENDIX VI
Meteorological Data of the Coffee Research Station, Balehonnur

Sl. No.	Description	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Apr.	May	June	July
1	Highest Maximum Temperature.....F...	78.5	81.5	83.2	81.5	83.5	86.0	88.5	92.0	91.3	88.1	86.1	80.1
2	Lowest Maximum Temperature.....F...	25.8	27.5	28.4	27.5	28.6	30.0	31.4	33.3	32.9	31.1	30.1	26.7
3	Highest Minimum Temperature.....F...	20.3	21.4	21.7	24.4	24.4	24.2	27.2	28.3	28.9	26.2	20.6	20.3
4	Lowest Minimum Temperature.....F...	19.4	19.2	19.5	19.5	17.6	18.3	17.8	19.5	21.4	21.7	20.6	19.8
5	Average Maximum Temperature.....F...	62.0	59.0	63.7	56.4	57.6	55.4	57.0	61.5	64.4	66.1	62.4	64.2
6	Average Minimum Temperature.....F...	69.2	77.1	79.5	79.2	80.2	81.2	84.4	88.1	87.4	80.4	79.8	72.3
7	Highest Humidity.....%	85	97	97	97	97	97	97	97	97	97	97	97
8	Lowest Humidity.....%	85	81	88	75	65	60	51	46	75	79	81	85
9	Average Humidity.....%	95	93	94	88	86	81	77	71	85	95	93	94
10	Highest No. of hours of bright sunshine ..	10-24	9-48	9-30	10-12	9-30	10-00	10-18	10-48	11-00	11-00	11-30	6-30
11	Lowest No. of hours of bright sunshine ..	0-00	0-00	2-00	1-42	1-00	2-00	5-00	5-30	1-42	2-00	0-00	0-00
12	Average No. of hours of bright sunshine ..	2-36	2-50	5-21	7-11	8-25	9-00	8-32	9-24	7-55	7-12	4-49	1-21
13	No. of days on which rainfall was below 10 cents ..	5	6	6	1	..	1	..	2	2	5	2	..
14	No. of days on which rainfall was between 10-15 cents..	12	8	9	3	..	..	..	..	1	6	5	6
15	No. of days on which rainfall was between 50-100 cents ..	4	1	5	3	..	..	..	..	4	1	1	5
16	No. of days on which rainfall was between 1-2" ..	6	..	6	3	..	..	..	..	1	2	4	10
17	No. of days on which rainfall was above 2" ..	3	..	..	..	..	..	..	..	1	..	5	10
18	Total number of rainy days during the month ..	25	9	20	9	..	..	..	1	7	9	15	31
19	Total rainfall during the month—Inches ..	23.14	2.44	17.30	7.27	0.05	0.04	..	1.18	8.01	5.21	20.35	50.49
	Millimeters ..	587.6	62.0	439.5	184.6	1.3	1.0	..	29.8	203.8	132.3	517.1	1282.4
20	Highest rainfall during the month—Inches ..	3.14	0.68	1.92	1.65	0.05	0.04	..	1.04	2.80	1.58	3.31	5.79
	Millimeters ..	79.8	17.3	48.8	41.9	1.3	1.0	..	26.3	71.2	40.1	84.1	147.1

APPENDIX VIII

Meteorological Data Observed at Coffee Research Substation, Chethalli, during 1957-58

Sl. No.	Meteorological Observations	Aug. 1957	Sept. 1957	Oct. 1957	Nov. 1957	Dec. 1957	Jan. 1958	Feb. 1958	Mar. 1958	Apr. 1958	May 1958	June 1958	July 1958
1	Highest Maximum Temperature in 'C.'	..	27.8	32.2	31.1	28.9	27.8	30.0	32.2	33.9	34.4	33.3	25.0
2	Lowest Maximum Temperature	..	21.7	26.1	25.0	24.0	24.4	25.6	27.8	30.0	28.3	26.7	21.1
3	Highest Minimum Temperature	..	22.2	23.9	23.9	21.1	21.1	20.0	22.8	22.2	23.9	22.8	22.2
4	Lowest Minimum Temperature	..	20.0	15.6	18.3	17.2	14.4	14.4	17.8	18.9	20.0	19.4	18.9
5	Average Maximum Temperature	..	23.7	29.1	27.8	26.9	26.7	27.2	30.1	32.2	31.7	27.5	22.6
6	Average Minimum Temperature	..	20.7	20.1	21.2	20.0	17.7	17.5	19.4	21.2	21.9	21.5	20.4
7	No. of days on which rainfall was below 10 cents	..	5	4	3	1	..	1	..	1	2	1	4
8	No. of days on which rainfall was between 10-50 cents	..	12	1	7	1	..	..	..	..	6	7	9
9	No. of days on which rainfall was between 50-100 cents	..	2	..	5	3	..	..	..	1	..	2	4
10	No. of days on which rainfall was between 1-2"	..	4	..	3	1	..	..	..	..	1	2	6
11	No. of days on which rainfall was above 2"	..	..	..	..	..	..	..	..	..	..	1	6
12	No. of rainy days during the month	..	23	5	18	6	..	1	..	2	9	14	29
13	Highest rainfall during the month in mm.	..	50.0	5.0	36.0	31.0	..	1	..	14.0	30.0	52.55	62.72
14	Total rainfall during the month in mm.	..	280.0	9.0	240.0	103.0	..	1	..	15.0	62.5	219.20	258.65
													717.60

APPENDIX IX
Rainfall Record of Coffee Research Substation, Chethalli, 1957-58

Sl. No.	Months	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	Average for 10 years	1957-58
1	August	mm. 478.7	546.3	219.2	233.7	160.8	269.2	389.9	308.1	147.8	255.0	301.0	283.7
2	September	.. 219.5	91.2	149.1	351.8	242.3	57.9	45.0	103.6	144.5	63.0	146.6	9.4
3	October	.. 253.4	92.5	224.8	82.5	162.1	209.5	353.3	195.1	273.1	281.9	212.9	243.8
4	November	.. 3.3	132.6	2.5	102.9	85.9	..	..	..	19.1	130.8	47.7	105.4
5	December	.. 26.6	2.3	..	..	..	53.6	..	35.3	..	..	11.47	..
6	January	.. 12.7	0.8	..	..	..	..	..	..	12.7	..	2.5	1.3
7	February	.. 10.2	..	18.0	..	2.3	..	14.7	..	0.8	..	4.6	..
8	March	.. ..	0.5	..	55.1	..	4.6	31.0	11.7	4.6	3.8	11.2	15.2
9	April	.. 120.7	96.0	30.0	60.2	111.0	54.4	117.3	142.5	125.0	62.2	92.5	63.5
10	May	.. 96.5	279.9	94.2	106.4	78.5	26.2	152.1	296.9	74.4	209.3	141.5	221.5
11	June	.. 267.5	174.0	173.5	227.3	202.3	309.1	297.4	331.2	474.2	310.9	277.6	261.4
12	July	.. 315.7	389.9	726.4	529.8	301.2	827.8	651.8	133.3	552.5	565.7	499.4	719.6
TOTAL mm. ..		180.4	180.5	163.8	175.5	135.6	181.2	205.3	155.8	182.9	188.2	174.9	192.5

APPENDIX X

Soil Cultivation Experiment

Locality: Coffee Research Station, Balehonnur.

Design: Randomized Blocks.

Treatments: 6.

Plot Size: $4 \times 20 = 80$ plants (4.5 cents).

Total area under experiment: 1.08 acres.

Year of commencement: 1954-55.

Replications: 4.

Variety: Coorgs arabica.

Age: 30 years.

Spacing: 5 feet $\times$ 5 feet.

Treatments	Yield of ripe cherry in lb. per acre				Average for 3 years	Calculated yield of clean coffee in cwt. per acre				Average for 3 years
	1954-55	1955-56	1956-57	1957-58		1954-55	1955-56	1956-57	1957-58	
A. Trenching $1\frac{1}{2} \times \frac{3}{4} \times 5'$	3204	4779	2097	4058	3635	5.27	7.22	3.34	6.23	5.60
B. Trenching $\frac{3}{4} \times \frac{3}{4} \times 5'$..	4092	3030	2609	5195	3611	6.85	4.40	4.10	7.97	5.49
C. Renovation pitting $1\frac{1}{2} \times \frac{3}{4} \times 3'$..	3673	3382	3475	3719	3525	5.95	5.28	5.65	5.53	5.49
D. Deep digging—November	3872	3273	2909	4270	3481	6.05	5.25	4.45	6.55	5.42
E. Light digging—November	3855	2798	2739	3618	3051	6.56	4.29	4.30	5.55	4.71
F. Control (Weeding only)	3873	3147	3046	3477	3223	6.38	4.83	4.78	5.17	4.93
General Mean	3762	3397	2811	4056	3421	6.18	5.20	4.43	6.17	5.27
S.E.M.	..	588.7	477.4	354.3	445.4					
Significance	..	Basic	No	No	No					

APPENDIX XI

Soil Management Experiment

Locality: Coffee Research Station, Balehonnur.
Design: Randomized Blocks.
Treatments: 7.
Plot Size: $5 \times 16 = 80$ plants (4.5 cents).
Age: 30 years.

Year of commencement: 1954-55.
Replications: 4.
Variety: Coorgs arabica.
Area under experiment: 1.26 acres.
Spacing: 5 feet $\times$ 5 feet.

Treatment	Yield of ripe cherry in lb. per acre					Calculated yield of clean coffee in cwt. per acre				
	1954-55	1955-56	1956-57	1957-58	Average for 3 years	1954-55	1955-56	1956-57	1957-58	Average for 3 years
A. Deep digging—August	6698	5790	1972	4003	3922	10.65	8.89	3.05	6.33	6.09
B. Light digging—August	6175	7054	2393	4004	4484	10.34	10.04	3.59	6.33	6.65
C. Deep digging—November	4949	6373	1757	4752	4294	8.01	9.78	2.74	7.18	6.57
D. Light digging—November	5842	7232	2192	4026	4483	9.78	10.99	3.36	6.08	6.81
E. Deep digging—April	5543	6368	1743	4329	4147	9.12	9.06	2.71	6.54	6.10
F. Scuffling—April	4451	5573	1644	4616	3944	6.96	8.71	2.48	7.40	6.20
G. Control (Weeding only)	6151	5184	2560	3830	3858	9.96	7.60	4.08	5.98	5.89
General Mean	5687	6225	2037	4222	4161	9.26	9.29	3.14	6.55	6.33
S.E.M.	540.7	740.8	237.6	593.0						
Significance	Basic	No	No	No						

APPENDIX XII

Manurial Experiment on Robusta

Locality: Coffee Research Station, Balehonnur.

Design: Randomised Blocks.

Treatments: 3.

Total area under experiment: 0.85 acre.

Year of commencement: 1951-52.

Replications: 6.

Plot size—Gross: $4 \times 8 = 32$ plants (4.7 cents).

Net: $2 \times 6 = 12$ plants (1.8 cents).

Treatments	Yield of ripe cherry in lb. per acre						Yield of clean coffee in cwt. per acre					
	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57
A. Manured at N P K 40-30-40	1793	2427	3231	2494	4099	2724	4118	3.02	4.78	6.01	4.01	7.78
.. ..	..	..	..	..	..	..	..	..	..	..	..	..
B. Manured at 80-30-40	1804	2175	2710	2338	4932	2452	5705	3.27	4.35	4.64	3.76	4.60
.. ..	..	..	..	..	..	..	..	..	..	..	..	..
C. Control (no manure)	1331	2333	3231	2254	4826	2145	4864	2.44	4.60	5.41	3.62	9.06
.. ..	..	..	..	..	..	..	..	..	..	..	..	..
General Mean	1625	2311	3057	2362	4619	2440	4896	2.91	4.58	5.35	3.80	8.70
S.E.M.	..	231.8	392.1	259.0	386.6	261.2	505.0	..	..	..	..	..
Significance	Basic	No	No	No	No	No	No	..	..	..	..	..

APPENDIX XIII

*Robusta Manurial and Pruning Experiment, Badra Estate, Balehonnur**Locality:* Badra Estate, Balehonnur.*Design:* Latin Square.*Treatments:* 6.*Plot size:* Gross: $6 \times 10 = 60$ plants (8.8 cents).*Year of commencement:* 1952-53.*Replications:* 6.*Total area under experiment:* 3.17 acres.*Net Plot:* $4 \times 8 = 32$ plants (4.7 cents).

Treatments	Yield of ripe cherry in lb. per acre					Yield of clean coffee in cwt. per acre				
	1952-53	1953-54	1954-55	1955-56	1956-57	1952-53	1953-54	1954-55	1955-56	1956-57
A. Control (no manure) ..	..	3836	3417	4178	3340	5465	3411	6.80	5.49	7.09
B. Pruned (no manure) ..	..	3586	3346	3889	3657	5507	3747	6.31	5.67	7.31
N P K										
C. Manure at 40-30-40 ..	..	3707	3705	3687	4739	5100	3262	6.48	5.96	6.91
D. ,, 80-30-40 ..	..	4038	3623	4133	4232	5236	3616	7.10	5.39	7.75
E. ,, 40-30-40 + Pruned ..	..	4265	3664	5046	4623	5178	3574	7.49	5.89	10.36
F. ,, 80-30-40 + Pruned ..	..	3925	3665	4164	4677	4928	3609	6.79	6.68	7.81
General Mean	..	3893	3570	4183	4212	5235	3537	6.81	5.88	7.87
S.E.M.	..	693.7	432.2	421.5	425.8	429.1	300.9			
Significance	..	Basic	No	No	No	No	No			

APPENDIX XIV

Robusta Manurial and Pruning Experiment, Devadhanam Estate, Balehonnur

Locality: Devadhanam Estate, Balehonnur.

Design: Latin Square.

Treatments: 6.

Plot size: Gross: $6 \times 10 = 60$ plants (8.8 cents).

Year of commencement: 1952-53.

Replications: 6.

Total area under experiment: 3.17 acres.

Net Plot: $4 \times 8 = 32$ plants (4.7 cents).

Treatments	Yield of ripe cherry in lb. per acre					Yield of clean coffee in cwt. per acre							
	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	
A. Control (no manure) ..	..	5428	3097	3682	2975	6697	2632	9.27	4.98	6.25	4.78	12.56	4.53
B. Pruned (no manure) ..	..	5983	2812	4393	2604	5387	2501	8.93	4.52	8.24	4.18	10.10	4.46
C. Manure at 40-30-40 ..	..	5817	3472	3781	2546	6472	2756	8.50	5.58	7.09	4.77	12.13	4.61
D. " 80-30-40 ..	..	5688	3466	4543	2894	5872	3081	9.82	5.03	8.92	5.17	11.01	5.35
E. " 40-30-40 + Pruned ..	..	6545	3167	4156	3221	7419	3294	11.52	5.09	8.53	6.33	14.51	6.23
F. " 80-30-40 + Pruned ..	..	6940	3371	4699	3078	7294	3244	10.79	6.27	8.81	5.77	14.26	5.93
General Mean ..	..	5917	3231	4209	2886	6524	2918	10.31	5.25	7.97	5.17	12.43	5.19
S.E.M. ..	..	417.2	333.3	390.3	346.8	514.8	262.2						
Significance ..	..	Basic	No	No	No	No	No						

APPENDIX XV

Experiment on the Influence of Topping on Growth and Yield of Robusta

Locality: Byregudda Estate, Balehonnur.

Year of commencement: 1951-52.

Design: ABBA method.

Replications: 12.

Treatments: 2.

Total area under experiment: 1.43 acres.

Plot size: $4 \times 8 = 32$ plants (5.95 cents).

Treatments	Mean stem girth measurements in cm.			Yield of ripe cherry in lb. per acre		
	1955- 56	1956- 57	1957- 58	1955- 56	1956- 57	1957- 58
A. Topped at 3 feet height ..	5.73	6.58	6.95	469	532	1285
B. Topped at 4 feet height ..	5.64	6.41	6.77	668	654	1337
General Mean ..	5.69	6.50	6.86	568	593	1311
S.E.M. ..	..	..	.23	71.7	46.6	271.8
Significance ..	..	..	No	No	No	No

APPENDIX XVI

Mulching Experiment—Coffee Research Station, Balehonnur

Locality: Coffee Research Station, Balehonnur.

Year of commencement: 1956-57

Design: Randomised Blocks.

Replications: 4.

Treatments: 6.

Variety: Arabica selections.

Plot size: Gross: 35 plants (2.89 cents).

Total area under experiment: 0.68 acres.

Net: 15 plants (1.24 cents).

Treatments	Mean stem girth measurements in cm.			Yield of ripe cherry in lb. per acre
	1957	1958	Increase over pre- vious year	
A. Control (no mulch) ..	1.5	2.1	0.63	61
B. Mulching with dry leaves at 3 tons per acre ..	1.4	2.0	0.61	68
C. Mulching with cherry husk at 3 tons per acre ..	1.7	2.4	0.67	95
D. Cover cropping ..	1.5	2.2	0.62	174
E. Green manure before monsoon ..	1.3	2.1	0.75	118
F. Green manure after mon- soon ..	1.3	2.0	0.62	47
General Mean ..	1.4	2.1	0.65	94
S.E.M. ..	0.34	0.49	0.23	29.8
Significance ..	Basic	No	No	Basic

APPENDIX XVII

*Mulching cum Manurial Experiment**Locality:* Coffee Research Station, Balehonnur.*Design:* Randomized Blocks.*Treatments:* 6*Plot size:* Gross: 35 plants (2.89 cents).

Net: 15 plants (1.24 cents).

Year of commencement: 1956-57.*Replications:* 4.*Variety:* Arabica selections.*Total area under experiment:* 0.68 acre.

Treatments	Mean stem girth measurements in cm.			Yield of ripe cherry in lb. per acre 1957-58
	1957	1958	Increase over pre- vious year	
N P K				
A. Manured with 20-30-40 ..	1.4	2.3	0.97	393
B. Manured with 40-30-40 ..	1.2	2.1	0.86	197
C. Manured as in A + Dry leaf mulch at 3 tons per acre ..	1.4	2.5	1.16	690
D. Manured as in B + Dry leaf mulch at 3 tons per acre ..	1.3	2.4	1.13	742
E. Manured as in A + Cherry husk mulch at 3 tons per acre	1.5	2.4	0.84	371
F. Manured as in B + Cherry husk mulch at 3 tons per acre ..	1.4	2.4	1.02	358
General Mean	1.3	2.4	1.00	458
S.E.M.	0.34	0.48	0.45	245.7
Significance	Basic	No	No	Basic

APPENDIX XVIII

Germination Experiment—Composition of Seedbeds

TRIAL I		TRIAL II	
Treatments	Mean per- centage of germi- nation	Treatments	Mean per- centage of germi- nation
A. Soil	71.98	A. Soil	61.38
B. Jungle Soil	63.80	B. Soil + Sand	64.68
C. Jungle Soil + Sand (1:1) ..	64.95	C. Soil + Compost	66.50
D. Jungle Soil + Compost + Sand (1:1:1)	69.58	D. Soil + Compost + Sand (1:1:1)	68.48
E. Jungle Soil + Compost + Sand (2:2:1)	72.25	E. Soil + Compost + Sand (2:1:1)	65.13
F. Jungle Soil + Compost + Sand (3:3:1)	68.95	F. Soil + Compost + Sand (1:2:1)	70.28
General Mean	68.58	General Mean	66.07
S.E.M.	2.14	S.E.M.	2.71
Significance	No	Significance	No

APPENDIX XIX

Germination Experiment—Effects on Drying Seeds

Treatments	Mean percentage germination of seeds sown on				
	28-1-1958	20-2-1958	24-3-1958	28-4-1958	27-5-1958
A. Sun drying with parchment cover intact ..	75.1	72.6	68.4	44.4	19.2
B. Sun drying without parchment cover ..	69.4	65.4	45.0	55.1	36.8
C. Shade drying with parchment cover intact ..	67.0	60.7	54.6	23.4	5.1
D. Shade drying without parchment cover ..	53.9	55.7	33.7	23.6	9.8
General Mean ..	66.3	63.6	50.4	36.6	17.7
S.E.M. ..	2.13	1.62	3.30	2.52	3.57
Significance ..	Yes**	Yes**	Yes**	Yes**	Yes**
C.D. ..	9.8	7.4	15.2	11.6	16.4
	<u>ABCD</u>	<u>ABCD</u>	<u>ACBD</u>	<u>BADC</u>	<u>BADC</u>

APPENDIX XX

Gibberellic Acid—Germination Trial of Arabica Coffee Seeds

Treatments	Mean percentage of germination of seeds sown on	
	26-6-1957	10-2-1958
A. Control ..	31.5	68.9
B. Gibberellic acid 10 p.p.m. ..	28.0	68.8
C. Gibberellic acid 25 p.p.m. ..	15.5	67.2
D. Gibberellic acid 50 p.p.m. ..	23.5	65.3
E. Gibberellic acid 100 p.p.m. ..	..	70.7
General Mean ..	24.6	68.2
S.E.M. ..	2.50	3.52
Significance ..	Yes**	No
C.D. ..	11.50	
	<u>ABDC</u>	

Remarks: Only transformed ($\sin^2 \theta$) values have been given.

APPENDIX XXI (A)

*Gibberellic Acid—Vegetative Propagation of Coffee**Date of planting: 27-6-1957. Date of Examination: 10-10-1957.**Cuttings dipped for 24 hours*

Treatments	Percent- age rooted	Average No. of Main roots	Average length of Main roots
Gibberellic acid 10 p.p.m.			
1st Node ..	10	1.5	9.3
2nd Node ..	10	1.0	4.2
4th Node ..	5	1.0	11.7
Gibberellic acid 25 p.p.m.			
2nd Node ..	15	1.7	5.6
3rd Node ..	5	1.0	5.5
Gibberellic acid 50 p.p.m.			
2nd Node ..	15	1.7	3.4

APPENDIX XXI (B)

*Gibberellic Acid—Vegetative Propagation of Coffee**Date of planting: 27-6-1957.**Date of Examination: 10-10-1957.**Cuttings treated for 3 minutes*

Treatments	Percent- age rooted	Average No. of Main roots	Average length of Main roots
Control			
1st Node ..	30	4.67	8.14
2nd Node ..	60	4.25	7.89
3rd Node ..	50	4.00	6.67
4th Node ..	10	3.00	4.61
Gibberellic acid 10 p.p.m.			
1st Node ..	50	3.80	8.16
2nd Node ..	75	4.67	9.54
3rd Node ..	35	2.71	10.24
4th Node ..	10	3.00	10.55
Gibberellic acid 50 p.p.m.			
1st Node ..	40	2.50	5.60
2nd Node ..	60	4.60	9.26
3rd Node ..	50	3.50	8.99
4th Node ..	20	2.00	6.31
Gibberellic acid 100 p.p.m.			
1st Node ..	35	4.00	9.71
2nd Node ..	35	5.29	8.93
3rd Node ..	25	3.40	6.63
4th Node ..	16	2.25	8.47

APPENDIX XXII (A)

Effect of Gibberellic Acid on the Height and Internode Length of Seedlings

Treatments Gibberellic acid	Mean Increase in Height				Mean Length of Internodes			
	Applied to Soil		Sprayed to Leaves		Applied to Soil		Sprayed to Leaves	
	17-7-57 to 5-8-57	6-8-57 to 17-9-57	17-7-57 to 5-8-57	6-8-57 to 17-9-57	3rd inter- node	4th inter- node	3rd inter- node	4th inter- node
0 p.p.m.	0.29	1.15	0.73	1.13	1.08	1.23	1.09	1.3
10 p.p.m.	0.28	1.30	0.38	1.20	1.39	1.20	1.40	..
50 p.p.m.	0.60	1.45	0.57	4.08	1.33	1.27	4.06	3.0
100 p.p.m.	0.42	1.34	0.83	5.40	1.37	1.50	5.29	3.2
Significance	No	No	No	Yes	No	..	Yes	..
S.E.M.	0.10	0.19	0.24	0.93	0.15	..	0.40	..
C.D. (5%)	..	..	..	2.80	..	..	1.19	..

APPENDIX XXII (B)

Effect of Gibberellic Acid on the Shoot and Root Weight in gm. of Seedlings

Gibberellic acid p.p.m.	Applied to Soil in gm.			Sprayed to Leaves in gm.		
	Shoot	Root	Shoot/Root	Shoot	Root	Shoot/Root
0 p.p.m.	2.84	1.81	1.569	2.10	0.98	2.143
10 p.p.m.	2.94	1.72	1.709	1.92	0.72	2.667
50 p.p.m.	3.07	1.66	1.849	2.02	0.91	2.220
100 p.p.m.	3.29	1.69	1.946	3.02	1.45	2.088
Significance	No	No	..	Yes	Yes	..
S.E.M.	0.17	0.10	..	0.18	0.08	..
C.D. (5%)	..	..	..	0.56	0.23	..

APPENDIX XXIII

Soil Cultivation Experiment—Coffee Research Substation, Chethalli

Locality: Coffee Research Substation, Chethalli.
 Design: Latin Square.
 Treatments: 6.
 Plot Size: Gross: 160 plants; Net: 112 plants.

Year of commencement: 1953-54.
 Replications: 6.
 Variety: Coorgs Arabica.
 Total area under experiment: 4.80 acres.

Treatments	Yield of ripe cherry in lb. per acre			Yield of clean coffee in cwt. per acre		
	1954-55	1955-56	1956-57	1954-55	1955-56	1956-57
A. Trenching 1½ feet deep ..	..	1733	1710	7001	3350	3350
B. Trenching ¾ feet deep ..	..	1535	1680	7321	3171	3171
C. Renovation pitting ..	..	1763	1792	7136	2940	2940
D. Light digging ..	..	1358	1920	7106	3127	3127
E. Heavy digging ..	..	1613	1920	7047	3526	3526
F. Control (Weeding only) ...	..	1920	1837	7847	3117	3117
General Mean ..	..	1650	1810	7243	3205	3205
S.E.M. ..	..	8.89	6.81	1031.40	365.80	365.80
Significance ..	..	No	No	No	No	No

APPENDIX XXIV

*Comparative Trials of Clonal Progeny—B.A. Series I**Locality:* Balehonnur (Mysore State).*Variety:* Arabica Hybrids.*Replications:* 8.*Area of Experimental Blocks:* 59.5 cents.*Guard Rows:* One on either side.*Mean Yield of Replications:* Calculated yield of clean coffee in cwt. per acre (1,200 plants)*Lay-out:* Randomised Block.*Plot:* 3 plants in a row.*Treatments:* 20 cultures of B.A. series.*Spacing:* 6' × 6'.*Shade:* Natural shade.

Cultures	Yield—cwt.				Cultures	Yield—cwt.			
	1954-55	1955-56	1956-57	1957-58		1954-55	1955-56	1956-57	1957-58
B.A. 5 ..	0.60	1.49	0.95	7.34	B.A. 24 ..	1.14	0.31	2.48	9.01
B.A. 6 ..	1.05	1.68	1.07	5.02	B.A. 25 ..	1.44	1.11	1.47	10.55
B.A. 11 ..	2.25	2.84	3.95	11.01	B.A. 26 ..	0.75	1.41	1.79	4.41
B.A. 12 ..	5.22	3.35	2.34	10.92	B.A. 27 ..	1.05	1.51	1.18	6.57
B.A. 13 ..	2.79	1.19	3.65	9.14	B.A. 30 ..	0.48	1.26	1.23	6.92
B.A. 19 ..	5.76	2.21	2.29	8.24	B.A. 31 ..	2.85	3.94	0.98	6.42
B.A. 20 ..	3.15	1.51	3.12	6.57	B.A. 32 ..	1.08	1.60	0.49	3.68
B.A. 21 ..	0.96	1.08	1.59	9.99	B.A. 34 ..	1.41	1.68	0.3	2.64
B.A. 22 ..	2.43	2.39	1.65	7.50	B.A. 35 ..	2.61	2.88	2.86	6.82
B.A. 23 ..	3.45	2.26	3.05	9.73	B.A. 36 ..	2.04	2.18	0.97	10.74

APPENDIX XXV

*Comparative Trials of Clonal Progeny—B.A. Series II**Locality:* Balehonnur (Mysore State).*Variety:* Arabica Hybrids.*Replications:* 6.*Area of Experimental Block:* 45.0 cents.*Spacing:* 6' × 6'.*Guard Rows:* One on either side.*Mean Yield of Replications:* Calculated yield of clean coffee in cwt. per acre (1,200 plants)*Lay-out:* Randomised Block.*Plot:* 3 plants in a row.*Treatments:* 15 arabica cultures of B.A. series and seedling progeny of 645 $\frac{1}{2}$ (B.A. 19).*Shade:* Natural shade.

Cultures	Yield—cwt.		Cultures	Yield—cwt.	
	1956-57	1957-58		1956-57	1957-58
B.A. 1 ..	1.90	3.49	B.A. 15 ..	0.10	0.85
B.A. 4 ..	1.12	3.46	B.A. 16 ..	4.49	5.21
B.A. 7 ..	0.20	4.13	B.A. 17 ..	0.15	2.31
B.A. 8 ..	0.22	0.14	B.A. 18 ..	5.49	5.30
B.A. 9 ..	1.46	4.22	B.A. 19 (645 $\frac{1}{2}$) ..	2.75	2.21
B.A. 10 ..	1.07	2.91	B.A. 28 ..	6.15	5.44
B.A. 13 ..	1.90	4.62	B.A. 29 ..	0.63	3.39
B.A. 14 ..	0.20	2.38	B.A. 33 ..	2.78	3.14

APPENDIX XXVI

*Comparative Trials of Clonal Progeny—B.R. Series I**Locality:* Balehonnur (Mysore State).*Variety:* Robusta.*Treatments:* 10 cultures of the B.R. series.*Replications:* 9.*Spacing:* 9' × 9'.*Treatments:* 10 cultures of the B.R. series are: B.R. 2, B.R. 3, B.R. 5, B.R. 6, B.R. 7, B.R. 9, B.R. 11, B.R. 12, B.R. 15, and B.R. 17.*Mean Yield of Cultures:* Calculated yield of clean coffee in cwt. per acre (538 plants)*Lay-out:* Randomised Block.*Plot:* 3 Plants in a row.*Guard Row:* One on either side.*Shade:* Natural shade.*Area of the Experimental Block:* 96 cents.

Cultures	Yield—cwt.		
	1955-56	1956-57	1957-58

B.R. 2	0.4	0.81	3.87
B.R. 3	1.7	0.98	6.73
B.R. 5	1.1	1.04	5.78
B.R. 6	2.9	1.89	8.24
B.R. 7	1.4	2.28	4.75
B.R. 9	1.8	0.43	8.80
B.R. 11	1.5	1.10	4.96
B.R. 12	4.2	0.93	8.78
B.R. 15	0.3	0.82	3.61
B.R. 17	1.4	0.81	1.14

APPENDIX XXVII

*Comparative Trials of Clonal Progeny**Locality:* Balehonnur (Mysore State).*Variety:* Robusta.*Treatments:* 9 cultures of the B.R. series and seedling progeny of S. 274 (Robusta).*Spacing:* 9' × 9'.*Lay-out:* Randomised Blocks.*Plot:* 3 Plants in a row.*Guard Row:* One on either side.*Shade:* Natural shade.*Replications:* 8.*Area of the Experimental Plot:* 93 cents.*Treatments:* The cultures of the B.R. series are: B.R. 1, B.R. 4, B.R. 6, B.R. 8, B.R. 10, B.R. 13, B.R. 14, B.R. 16, B.R. 17. S. 274 (Robusta) Seedling Progeny.*Mean Yield of Replications:* Calculated yield of clean coffee in cwt. per acre (538 plants)

Cultures	Yield—cwt.	
	1956-57	1957-58

B.R. 1	0.44	0.35
B.R. 4	0.97	1.59
B.R. 6	0.55	2.53
B.R. 8	0.66	1.68
B.R. 10	1.23	2.53
B.R. 13	1.03	1.95
B.R. 14	1.99	2.57
B.R. 16	0.58	2.19
B.R. 17	0.52	1.04
S. 274 Robusta Seedling	0.92	2.07

APPENDIX XXVIII

*Species, Varieties, Forms and Selections of Coffee Obtained from Foreign Institutions
and Planted on the Station since 1953*

Species other than arabica

- | | |
|---|--------------------------|
| I. 1. <i>Coffea robusta laurentii</i> . | 26. S. 8. Tafari-kela. |
| 2. <i>C. canephora</i> . | 27. S. 9 Arba Gougou. |
| 3. <i>C. canephora</i> (Game). | 28. S. 12 Kaffa. |
| 4. <i>C. robusta</i> from Saigon. | 29. Kabare. |
| 5. <i>C. robusta</i> from Monrovia. | 30. S. 16 Wollamo. |
| 6. <i>C. robusta</i> L. 215 and L. 36. | 31. S. 17 Yrgalem. |
| II. 1. <i>C. liberica aruwimiensis</i> . | 32. S. 2-B Ennerea. |
| 2. <i>C. liberica arnoldiana</i> . | 33. Salvador. |
| III. 1. <i>C. Dewevrei</i> . | 34. Togokouma. |
| 2. <i>C. Dewevrei excelsa</i> . | 35. Macenta. |
| IV. <i>C. stenophylla</i> . | 36. Colombie. |
| V. <i>C. congensis</i> . | 37. Costa Rica. |
| VI. <i>C. racemosa</i> (Two types). | 38. Gimma M'Buni. |
| VII. <i>C. eugenoides</i> . | 39. Dalle (Mixed green). |
| VIII. <i>C. salvatrix</i> . | 40. Dilla and Alghe. |
| IX. <i>C. rupestris</i> . | 41. Dalle (Melville). |
| X. Hybrids— | 42. Rume Sudan. |
| Kawisari—B. | 43. Mazon. |
| Kawisari—D. | 44. Reunion. |
| XI. <i>Varieties, forms and selections of arabica</i> | 45. Mysore. |
| 1. Bourbon amarelo. | 46. Java Fouban. |
| 2. Bourbon vermelho | 47. Nkougam. |
| 3. Caturra amarelo. | 48. Kenya. |
| 4. Laurina Maragogyne. | 49. Kouti. |
| 5. Mundo Novo. | 50. Martinique. |
| 6. Typica. | 51. Antique. |
| 7. Bourbon. | 52. Tumbadir. |
| 8. Pache. | 53. Laspalmas. |
| 9. Local Bronze. | 54. Green Lipped. |
| 10. Le Roy (Laurina). | 55. Puerto Rico. |
| 11. Sumatra. | 56. Gimma Galla Sidamo. |
| 12. Jackson. | 57. Madagascar. |
| 13. Surinam. | 58. Sudan Barbuk. |
| 14. Blue Mountain—Kenya. | 59. Guinea Pita. |
| 15. Blue Mountain. | 60. Amphillo. |
| 16. San Ramon. | 61. Erecta. |
| 17. Philippinean. | 62. Geisha. |
| 18. Goudaloupe. | 63. KP. 423. |
| 19. Bourbon Mayagese. | 64. N. 205. |
| 20. Pretoria. | 65. H. 66. |
| 21. Columnaris. | 66. KP. 162. |
| 22. Kona. | 67. KP. 532. |
| 23. Padang. | 68. N. 39. |
| 24. Murta. | 69. N. 197. |
| 25. Mibirizi. | 70. K. 7. |
| | 71. Dilla (Melville). |

APPENDIX XXVIII—(Contd.)

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|---------------------------------|--|
| 72. Cundinamarca. | 95. Semperflorens. |
| 73. Mokka. | 96. Polysperma. |
| 74. Java Noun. | 97. Maragotype vermelo. |
| 75. Nicaragua. | 98. Caturra. |
| 76. Moka Blao. | 99. Cumbaya normal. |
| 77. Granza Blonay. | 100. Cumbaya abnormal. |
| 78. Mibirizi De Mulungu. | 101. Villalobus. |
| 79. Local Bronze De Mulungu. | 102. Kents (Kenya). |
| 80. Barbarina. | 103. <i>C. arabica</i> H.I. |
| 81. Darnum. | 104. <i>C. arabica</i> A.C. 98. |
| 82. Wolkite. | 105. <i>C. arabica</i> S. 16 (P.R.) |
| 83. Maragotype. | 106. F. 502. |
| 84. Moka Dilla Sidamo. | 107. <i>C. arabica</i> Rume Sudan. |
| 85. San Salvador. | 108. A.C. 53. |
| 86. Harar Arba Gougou. | 109. S.L. 34. |
| 87. Limmu Gimma Kaffa. | 110. Kent (Ruiru). |
| 88. Haraar Dugda Lemita Arussi. | 111. Self-pollinated Geisha type from
3 individual trees. |
| 89. Badabuna Gimma Kaffa. | 112. Puerto Rican Selections from
private estates, 4 types. |
| 90. Babaca Kaffa. | 113. Columnaris—2 types. |
| 91. Misan Taffari Kaffa. | 114. Wush Wush. |
| 92. Eniamba Kaffa. | 115. B.E. 10. |
| 93. Harrar Baca Haraar. | |
| 94. Purpurescens. | |
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APPENDIX XXIX

*Yield Data of Multiple Stem vs. Single Stem System of Growing Coffee—Experiment I**Locality:* Balehonnur (Mysore State).*Age of plants:* 12 years from seed.*Variety:* S. 288; S. 333; S. 433; S. 434 and Kents arabica (each variety having 12 rows of 16 plants in each row).*Period of conversion:* May 1950.*Lay-out:* AB, BA Pattern.*Shade:* Natural shade.*Spacing:* 6' × 6'.*Treatments:* A: Single Stem. B: Mutultiple Stem.*Area of Experimental Block:* 95.2 cents.

Year	Description of crop	Yield of ripe cherry (actual) in lb. and calculated yield of clean coffee in cwt./acre (1,200 plants)													
		A. Single Stem					B. Multiple Stem								
		S. 288	S. 333	Kents	S. 433	S. 434	Kents	Mean	S. 288	S. 333	Kents	S. 433	S. 434	Kents	Mean
1952	Ripe Cherry	63	83	19	7	22	22	36	21	8	7	4	5	3	8
	Clean Coffee	1.17	1.52	0.35	0.13	0.42	0.41	0.66	0.38	0.15	0.13	0.07	0.09	0.06	0.15
1953	Ripe Cherry	55	98	32	103	116	10	69	177	83	28	99	135	8	88
	Clean Coffee	1.02	1.82	0.60	1.92	2.16	0.18	1.28	3.28	1.53	0.52	1.83	2.52	0.15	1.64
1954	Ripe Cherry	243	421	226	227	416	374	318	463	338	370	452	643	160	404
	Clean Coffee	4.52	7.83	4.20	4.22	7.74	6.96	5.91	8.6	6.28	6.88	8.41	11.96	2.98	7.52
1955	Ripe Cherry	180	128	115	49	62	75	101	144	125	113	73	56	84	99
	Clean Coffee	3.34	2.38	2.13	0.91	1.15	1.39	1.88	2.68	2.32	2.12	1.36	1.04	1.56	1.85
1956	Ripe Cherry	643	597	404	328	539	248	460	880	622	267	225	367	117	413
	Clean Coffee	11.96	11.14	7.51	6.10	10.03	4.61	8.56	16.37	12.46	4.97	4.19	6.82	2.18	7.86
1957	Ripe Cherry	206	119	45	74	58	40	90	147	118	53	92	135	70	103
	Clean Coffee	3.83	2.21	0.84	1.38	1.08	0.74	1.68	2.73	2.19	0.99	1.41	2.52	1.30	1.86
1958	Ripe Cherry	904	982	253	348	653	362	584	445	310	140	196	224	227	257
	Clean Coffee	16.81	18.27	4.71	6.47	12.15	6.73	10.86	8.28	5.77	2.60	3.65	4.17	4.22	4.78
Mean	Ripe Cherry	327.71	346.86	156.29	162.29	266.57	161.57	236.88	325.29	229.14	139.71	163.00	223.57	95.57	196.05
	Clean Coffee	6.09	6.45	2.91	3.02	4.96	3.00	4.40	6.05	4.39	2.60	2.99	4.16	1.78	3.66

Note.—1. Six lb. of Ripe Cherry has been taken to yield 1 lb. of Clean Coffee.

2. During February 1958, one of the multiple stems in all the plants under Treatment B was cut down and a new sucker developed for the 2nd cycle.

3. On the aggregate of seven years yields the multiple stem plots have registered a decrease of 16.8% on the single stem plots.

Locality: Balehonnur (Mysore State).

Variety: Arabica Hybrids.

Treatments: 4 during the year of conversion.

Replications: 4.

Shade: Natural shade.

Lay-out: Randomised Blocks.

Plot: $4 \times 16 = 64$ plants.

Spacing: $6' \times 6'$.

Age of plants: 25 years from seed.

Period of conversion: March 1951.

Area of the Experimental Block: 105.8 cents.

Treatments are:—

A. Single Stem.

B. Primary branches on one side were pruned off during March 1951 to encourage free growth of suckers for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

C. Extended centring up to one foot from the centre was done during the year of conversion (March 1951) to facilitate free growth of three suckers for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from the ground level, retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

D. Except the two top primary branches, all the other branches were cut down during the year of conversion (March 1951) to facilitate free growth of three suckers. After crop harvest, during March 1952, the topmost primary branch was retained to act as a lung branch and the three suckers form the multiple stems.

Mean yield of ripe cherry (actual) in lb. and calculated yield of clean coffee in cwt. per acre (1,200 plants)

Treatments	Ripe Cherry (Actual)					Clean Coffee (calculated)								Mean of seven years cwt.	
	1952* lb.	1953 lb.	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.	1952* cwt.	1953 cwt.	1954 cwt.	1955 cwt.	1956 cwt.	1957 cwt.		1958 cwt.
A	38.63	47.14	208.46	100.44	190.83	393.70	256.9	1.08	1.31	5.81	2.80	5.32	10.98	7.17	4.92
B	22.11	12.24	262.16	92.31	192.90	388.90	222.6	0.62	0.34	7.31	2.58	5.40	10.85	6.21	4.76
C	24.62	26.11	272.46	110.06	251.00	380.00	267.70	0.68	0.73	7.66	3.07	7.00	10.60	7.47	5.32
D	38.38	34.73	246.84	99.38	225.49	371.00	257.25	1.07	0.97	6.77	2.77	6.29	10.35	7.18	5.06

* Crop of the year of conversion.

Note.—1. 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.

2. During February 1958, one of the multiple stems in all the plants under treatments B, C and D were cut down and a new sucker allowed to develop for the 2nd cycle.

3. On the aggregate of seven years yields treatment B has registered a decrease of 3.25% over that of the single stem (Treatment A) while Treatments C and D have registered an increase of 8.1% and 2.8% respectively over the single stem.

APPENDIX XXXI

*Yield Data of Multiple Stem vs. Single Stem System of Growing Coffee—Experiment III**Locality:* Balehonnur (Mysore State).*Variety:* Arabica Hybrids.*Treatments:* 2. A. Single stem. B. Multiple stem.*Replications:* 21.*Period of conversion:* March 1951.*Lay-out:* AB, BA Pattern.*Plot:* 16 plants in a row.*Age of plants:* 14 years from seed.*Shade:* Natural shade.*Area of the Experimental Plot:* 52 cents.*Spacing:* 6' × 6'.

Treatments	Mean yield of ripe cherry (actual) in lb. and calculated clean coffee in cwt. per acre (1,200 plants)															
	Ripe Cherry (actual)—lb.								Clean Coffee—cwt.							
	1952*	1953	1954	1955	1956	1957	1958	Mean	1952*	1953	1954	1955	1956	1957	1958	Mean
A	5.78	19.43	24.72	18.99	11.94	39.29	15.00	19.31	0.64	2.17	2.76	2.12	0.44	4.35	1.67	2.15
B	3.90	8.03	21.49	15.20	24.82	42.27	18.24	19.14	0.44	0.89	2.40	1.69	0.92	4.75	2.04	2.14

* Crop of the year of conversion.

Note.—1. 6 lb. of ripe cherry has been taken to yield one lb. of clean coffee.

2. During February 1958 one of the multiple stems in all the plants under Treatment B was cut down. A new sucker is developing for forming one of the multiple stems in the 2nd cycle.

3. On the aggregate of seven years yields the multiple stem plots have registered a decrease of 0.50% over the single stem plots.

APPENDIX XXXII

*Yield Data of Multiple Stem vs. Single Stem System of Growing Coffee**Locality:* Balehonnur (Mysore State).*Variety:* Robusta.*Lay-out:* Opposite quadrants on a rectangular block are on each of the 2 treatments.*Treatments:* 2. A. Single Stem.

B. Multiple Stem.

Shade: Natural shade.*Spacing:* 9' × 9'.*Replications:* 2.*Period of conversion:* September 1951.

Mean yield of ripe cherry per plot (actual) in lb. and calculated yield of clean coffee in cwt. per acre (538 plants)

Year	Description of Crop	Ripe cherry in lb. and clean coffee in cwt./acre	
		A. Single Stem	B. Multiple Stem
1953	Ripe Cherry	121.06	52.69
	Clean Coffee	1.33	0.58
1954	Ripe Cherry	110.30	153.63
	Clean Coffee	1.20	1.61
1955	Ripe Cherry	138.00	105.34
	Clean Coffee	1.50	1.15
1956	Ripe Cherry	312.00	213.5
	Clean Coffee	2.93	1.51
1957	Ripe Cherry	394.00	136.00
	Clean Coffee	4.30	1.49
1958	Ripe Cherry	229.63	168.00
	Clean Coffee	2.51	1.83
Mean	Ripe Cherry	217.50	138.19
	Clean Coffee	2.38	1.50

Note.—1. 5 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.

2. During March 1958 one of the multiple stems in all the plants was cut down and a new sucker developed for the 2nd cycle.

3. On the aggregate of six years yields the single stem plots have registered an increase of 58.7% over the multiple stem plots.

APPENDIX XXXIII

*Arabica Varietal Trial at the Coffee Research Substation, Chetalli P.O., Coorg (Mysore State)**Locality:* Chethalli, Coorg (Mysore State).*Size of plots:* 12 × 8 = 96 plants.*Spacing:* 6½' × 6½'.*Treatments:* 4. A. S. 446; B. S. 795; C. S. 645; D. S. 288.*Shade:* Natural shade.*Lay-out:* Latin Square.*Area of Experimental Block:* 1.49 acres.

Yield per acre of ripe cherry in lb. and calculated yield of clean coffee in cwt. per acre

Year	Description of Crop	Yield in ripe cherry in lb. and clean coffee in cwt./acre					Mean	S.E.M. %	Signifi- cant or not	Critical differ- ence	Conclusions
		A				D					
		S. 446	S. 795	S. 645	S. 288						
1952	Ripe Cherry .. Clean Coffee ..	875 1.30	255 0.38	193 0.29	133 0.20	364 0.54	23.48 ..	Yes ..	191 0.43	A B C D	
1953	Ripe Cherry .. Clean Coffee ..	3746 5.57	1897 2.82	1366 2.03	808 1.20	1954 2.91	16.22 ..	Yes ..	1095 1.63	A B C D	
1954	Ripe Cherry .. Clean Coffee ..	1541 2.29	3402 5.06	2478 3.69	1498 2.23	2230 3.32	14.18 ..	Yes ..	1096 1.63	B C A D	
1955	Ripe Cherry .. Clean Coffee ..	6939 8.84	9043 13.46	4865 7.24	4404 6.55	6063 9.02	..	Yes	..	B A C D	
1956	Ripe Cherry .. Clean Coffee ..	1997 3.00	8551 12.70	5821 8.60	4259 6.30	5157 7.65	..	Yes	..	B C D A	
1957	Ripe Cherry .. Clean Coffee ..	9208 13.70	10548 15.70	9422 14.02	8765 13.04	9486 14.12	..	No	..	B C A D	
1958	Ripe Cherry .. Clean Coffee ..	3000 4.58	15838 23.55	12584 18.75	8872 13.22	10074 15.03	9.21	Yes	2378 3.39	B C D A	

New Manurial Series: Yield record and percentage of floats in the harvest

Area of Experimental Plot: 0.76 acres.

No. of Plants per Sub-Plot: $5 \times 8 = 40$ (up to January 1955).

No. of Plants per Sub-Plot: $5 \times 4 = 20$ (from January 1955).

Shade: Artificial, Bamboo slats on pandal.

Guard Rows: One row all round the Block.

Annual Rate of Manuring: Nitrogen 60 lb, to the acre in three equal doses. Phosphoric Acid 30 lb, to the acre in two equal doses. Potash 40 lb, to the acre in two equal doses.

Year and Particulars	Average yield of ripe cherry in lb. and clean coffee in cwt. calculated to the acre Percentage of floats in the harvest						Standard error as % of gen. mean P=0.05	Signifi- cant or not	Conclusions
	A N	B NP	C NK	D NPK	E Control				
1957 (a) Ripe Cherry based on 20 plants ..	2406	3395	2466	3098	1632	8.60	689	Yes	<u>BDCAE</u>
1957 (b) Ripe Cherry based on 40 plants ..	4812	6790	4932	6196	3264	8.60	1378	Yes	<u>BDCAE</u>
1957 (a) Clean Coffee based on 20 plants ..	3.93	5.45	3.80	4.79	2.36	8.86	1.11	Yes	<u>BDACE</u>
1957 (b) Clean Coffee based on 40 plants ..	7.86	10.89	7.59	9.58	4.72	8.86	2.22	Yes	<u>BDACE</u>
1958 (a) Ripe Cherry based on 20 plants ..	2683	3465	2805	3282	2427	7.87	627	Yes	<u>BDCAE</u>
1958 (b) Ripe Cherry based on 40 plants ..	5365	6929	5610	6564	4854	7.87	1254	Yes	<u>BDCAE</u>
1958 (a) Clean Coffee based on 20 plants ..	3.81	4.94	3.86	4.53	3.27	8.37	1.05	Yes	<u>BDCAE</u>
1958 (b) Clean Coffee based on 40 plants ..	7.62	9.88	7.72	9.05	6.53	8.37	2.10	Yes	<u>BDCAE</u>
Average Ripe Cherry for 18 years ..	1954	2326	2025	2116	1659	3.94	2.39	Yes	<u>BDCAE</u>
Average Clean Coffee for 10 years ..	4.52	5.45	4.49	4.99	3.76	3.25	0.47	Yes	<u>BDACE</u>
1957 Percentage of floats by weight	9.58	11.36	10.19	11.85	11.16	6.62	2.18	No	<u>DBECA</u>
1957 Percentage of floats by volume	9.58	11.22	10.22	11.76	10.88	8.02	2.64	No	<u>DBECA</u>
1958 Percentage of floats by weight	8.26	9.64	9.42	8.70	8.12	8.20	2.23	No	<u>BCDAE</u>
1958 Percentage of floats by volume	8.40	10.36	10.22	8.96	8.66	9.69	2.78	No	<u>BCDEA</u>

APPENDIX XXXV

NPK Trials with Varying Levels of NPK Fundamental Manurial Experiments in the pH Cisterns

Area of Experimental Plot: 25 cents.

No. of Plants per Sub-Plot: One.

(Yield record and percentage of floats in the harvest)

Lay-out: Latin Square.

Spacing: 7½'.

Replications: 6.

Treatments: 6.

Started: 1950. Shade: Artificial coir matting over pandal.

Annual Rate of Manuring:

A. 20 lb. Nitrogen +30 lb. Phosphoric acid +40 lb. Potash to the acre

B. 30 " " +30 " " +40 " " " "

C. 45 " " +30 " " +40 " " " "

D. 30 " " +45 " " +40 " " " "

E. 30 " " +45 " " +60 " " " "

F. 45 " " +67.5 " " +90 " " " "

Average yield of ripe cherry and clean coffee in lb.
per plot and percentage of floats

Year and Particulars

Year and Particulars	Treatments						Standard error as % of gen. mean	Critical difference, P = 0.05	Significant or not	Conclusions
	A	B	C	D	E	F				
1957 Ripe Cherry ..	1.17	0.66	0.57	0.56	0.42	0.65	24.82	0.49	No	ABFCDE
1957 Clean Coffee ..	0.20	0.11	0.10	0.10	0.07	0.11	24.80	0.08	No	ABFCDE
1958 Ripe Cherry ..	2.40	2.03	4.04	2.26	2.85	2.69	25.65	2.05	No	CEFADB
1958 Clean Coffee ..	0.39	0.34	0.61	0.37	0.45	0.46	26.59	0.33	No	CFEADB
Average Ripe Cherry for 5 years	2.23	1.64	2.29	1.55	1.75	2.45	17.39	1.02	No	FCAEBD
Average Clean Coffee for 5 years	0.36	0.28	0.37	0.26	0.29	0.40	18.05	0.16	No	FACEBD
1957 Floats by weight ..	12.9	13.04	12.11	14.42	19.31	15.23	22.86	9.78	No	EFDBAC
1957 Floats by volume ..	11.65	9.82	11.00	14.86	17.56	14.53	15.02	5.87	No	EDFACB
1958 Floats by weight ..	18.39	18.70	19.35	21.30	18.85	16.13	7.69	4.26	No	DCEBAF
1958 Floats by volume ..	23.25	24.25	22.63	29.31	26.33	20.78	10.76	7.76	No	DEBACF

APPENDIX XXXVII

*N P K Trials with Varying Levels and Combinations (Arabica Manurial
Experiment at the Coffee Research Substation, Chethalli, Coorg*

Area of Experimental Plot: 2.28 acres.

Lay-out: Factorial design $4 \times 2 \times 2$.

No. of Plants per Sub-Plot: Gross: $7 \times 7 = 49$.
 Nett: $5 \times 5 = 25$.

Replications: 3.

Planted: $6\frac{1}{2}' \times 6\frac{1}{2}'$ square.

Variety of Coffee: S. 446—2nd generation.

Shade: Natural mixed shade.

Terraced and Planted: August 1952.

1st Manuring: May 1953.

Treatments: Nitrogen at 4 levels N_0 , N_1 , N_2 and N_3 .

$N_0 = 0$ lb. N; $N_1 = 60$ lb. N; $N_2 = 90$ lb. N; $N_3 = 120$ lb. N per acre.

Phosphoric acid at 2 levels P_0 and P_1 .

$P_0 = 0$ lb. P_2O_5 ; $P_1 = 30$ lb. P_2O_5 per acre.

Potash at 2 levels K_0 and K_1 .

$K_0 = 0$ lb. K_2O ; $K_1 = 40$ lb. K_2O per acre.

Tables of mean yields in lb. per plot

		N_0	N_1	N_2	N_3	Mean
K_0	..	375.4	689.8	683.6	733.1	103.4
K_1	..	429.6	545.1	662.1	659.2	95.7
Mean	..	67.1	102.9	112.1	116.0	

S.E. for means in the body of the table = 26.21.

		N_0	N_1	N_2	N_3	Mean
P_0	..	395.0	671.6	690.3	735.4	103.8
P_1	..	410.0	563.3	655.4	656.9	95.2
Mean	..	67.1	102.9	112.1	116.0	

S.E. for means in the body of the table = 26.21.

		K_0	K_1	Mean
P_0	...	1391.4	1100.9	103.8
P_1	..	1090.5	1195.1	95.2
Mean	..	103.4	95.7	

S.E. for means in the body of the table = 26.21.

The factors have not been significant.

Studies on the Effect of Aldrinised Fertilizers on the Yield of Coffee: Yield Record

Lay-out: Randomized Block.

Replications: 6.

Lay-out: Randomized Block.

Started: 1955.

Annual Rate of Manuring:—

[illegible]

A. 440 lb. of fertilizer mixture to the acre per year to give 80 lb. N., 45 lb. P_2O_5 , 60 lb. K_2O to be applied in three equal doses during (1) Pre-blossom, (2) Post-blossom—Pre-monsoon, (3) Post-monsoon.

B: Same as in (A) above + 2.25 lb. of Aldrin.

Year and Particulars	Average yield of ripe cherry in lb. calculated to the acre				Standard error as % of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	Treatments							
	A	B	C	D				
<i>Coffee Research Station, Balehonnur</i>								
1957 Ripe Cherry	..	5367	5125	5472	5599	4.38	712	<u>DCAB</u>
1958 Ripe Cherry	..	3751	3166	3354	3928	11.91	1274	<u>D'ACB</u>
<i>Coffee Research Substation, Chethalli</i>								
1957 Ripe Cherry	..	5399	5024	5661	7298	13.90	2447	<u>DCAB</u>
1958 Ripe Cherry	..	3660	3047	4067	3567	15.60	1684	<u>CADB</u>

APPENDIX XXXIX

Field Trials to find out the Maximum Economic Dose of Nitrogen and the Role of Phosphates and Potash in Balancing the Nitrogen Utilization—Yield Record 1957-58

Lay-out: Randomized Block.
Shade: Natural mixed shade.

Treatments: Main 6—Sub 4.
Started: May 1956.

Replications: 3.
Spacing: 5' x 5'.

50 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre.

A.	800	360	120	480	
B.	200	90	0	120	
C.	0	0	0	0	
D.	400	180	45	240	(Control).
E.	100	45	60	60	
F.					

Sub-Treatments:

1. Nitrogen with Phosphoric acid and Potash.
2. As in (one) + basal dressing of 1 lb. of finely ground rock phosphate per plant applied at the commencement of the experiment.
3. Nitrogen only + basal dressing of rock phosphate applied as above.
4. Nitrogen only.

Time and method of application:

50 lb. Nitrogen level given in two equated doses in March and October while all the rest are given in four equal doses in March, May, August and October—applied as a broad band within the drip circle of each plant under the leaf mulch.

Main Treatments	Yield of ripe cherry in lb. per plot of 9 plants (Totals of 3 replications)				Mean of main treatments		Standard error		Critical difference P=0.05		Conclusions	
	Sub-Treatments				1	2	3	4	Main treatments	Sub-treatments	Main treatments	Sub-treatments
A	35.7	44.9	37.8	41.5	13.33							
B	50.8	40.8	66.0	58.4	18.00							
C	49.1	107.7	51.5	62.8	22.60	10.09	6.53	9.91	4.29	Yes	No	No
D	35.6	37.6	44.9	50.0	14.01							
E	32.0	41.4	44.2	32.1	12.48							
F	35.8	42.6	44.4	49.2	14.33							
Mean of Sub-	12.22	17.50	16.07	16.22								

Main: C B F D A E
Sub: 2 4 3 1

APPENDIX XL

Studies on the Application of Nitrogen only in Divided Doses in Relation to Yield of Coffee (Ossoor Manurial Experiments)
Yield Record

Area of Experimental Plot: 0.80 acres. *Lay-out:* Randomized Block. *Replications:* 6.
No. of Plants per Plot: $8 \times 5 = 40$. *Spacing:* $6' \times 6'$. *Started:* June 1953. *Shade:* Natural mixed shade.

Annual Rate of Manuring:—

- A. 80 lb. Nitrogen only to the acre in one single dose.
 B. 80 " " " " in two equal doses of 40 lb. each.
 C. 80 " " " " in three doses: 30 lb., 20 lb. and 30 lb.
 D. Control—No treatment.

Year and Particulars	Average yield of ripe cherry in lb. cal- culated to the acre				Standard error as % of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	Treatments							
	A	B	C	D				
1957 Ripe Cherry	4791	3517	3909	3986	8.19	1000	No	A D C B
1958 Ripe Cherry	..	3315	3465	3621	4.42	578	No	C B D A
Average for 5 years	..	2859	2800	2790	5.72	492	No	D A B C

APPENDIX XLI

Studies on the Effect of Different Sources of Nitrogen on the Growth and Yield of Mature Yielding Coffee
Yield Record—1957-58

Locality: Shigode Estate. *Lay-out:* Latin Square. *Treatments:* 6. *Replications:* 6.
Area of Experimental Plot: 1.5 acres. *Spacing:* 5' x 5'. *Shade:* Natural mixed shade.
Started: 1956. *No. of Plants per Sub-Plot:* Gross: 7 x 10 = 70. Net: 5 x 8 = 40.

Annual Rate of Manuring:

Nitrogen 80 lb. to the acre applied in three doses.
 Phosphoric acid 45 lb. P_2O_5 applied in two equal doses.
 Potash 60 lb. to the acre applied in two equal doses.

Treatments:

- A. Control—No Manure.
 B. Required quantity of nitrogen applied as Calcium Ammonium Nitrate.
 C. " " " " Ammonium Sulphate.
 D. " " " " Urea.
 E. " " " " Chilean Nitrate.
 F. " " " " Ammonium Sulphate Nitrate.

Treatments	Yield of ripe cherry in lb. per plot						Total	Mean	Calculated yield per acre	Standard error as % of gen. mean	Critical difference $P=0.05$	Significant or not	Conclusions
	1	2	3	4	5	6							
A	52.9	35.0	62.3	62.9	88.7	75.3	377.1	62.85	2671				
B	68.1	25.5	44.2	39.2	70.3	65.4	312.7	52.11	2215				
C	80.1	68.5	32.9	78.6	62.9	54.3	377.3	62.89	2673	11.48	19.59	No	C A F E D B
D	55.7	36.5	59.5	64.9	43.2	62.6	322.4	53.73	2283				
E	58.2	53.1	42.3	74.0	67.1	30.4	325.1	54.18	2302				
F	87.1	57.8	66.2	65.3	57.4	34.6	368.4	61.40	2610				

Field Manurial Trials in Private Estates on *Arabica Coffee*—Yield Data

Treatments: Main 4; Sub 4. Lay-out: Randomized Split Plot. Shade: Natural mixed shade. Started: 1954.
No. of Plots per Sub-Plot: Gross: $10 \times 7 = 70$. Net: $8 \times 5 = 40$.

Main Treatments:

- A. Nitrogen at 40 lb. to the acre per annum
B. " at 60 " " " "
C. " at 80 " " " "
D. " at 100 " " " "

Sub-Treatments:

- N_1 : The required quantity of nitrogen applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.
 N_2 : The required quantity of nitrogen applied in three doses; once in the pre-blossom, once in the pre-monsoon and once in the post-monsoon period.
NP: The required quantity of nitrogen applied as above (N_2) + 30 lb. Phosphoric acid to the acre applied in two equal doses once in the pre-blossom and once in the post-monsoon period.
NPK: As in NP above + 40 lb. Potash to the acre applied in two equal doses once in the pre-blossom and once in the post-monsoon period.

Main Treatments	Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treat- ments	Standard error		Critical differ- ence $P=0.05$		Significant or not	Conclusions -
	Sub-Treatments					Main Plots	Sub- Plots	Main treat- ments	Sub- treat- ments		
	N ₁	N ₂	NP	NPK							
<i>Urvinkhan Estate—Mudigere Zone, Mysore. Spacing 6' x 6'. Replications 2.</i>											
1957	A	4.2	9.2	6.1	6.0	3.2					
	B	6.6	5.4	4.9	5.7	2.8					
	C	4.5	5.0	6.4	6.5	2.8	2.26	0.96	3.60	1.05	No No
	D	7.7	5.5	6.7	5.5	3.2					Main: <u>A D B C</u> Sub: <u>N₂ NP NPK N₁</u>
Mean of Sub-treatments											
1958	A	11.3	10.5	10.1	11.4	5.4					
	B	11.0	9.6	9.9	10.2	5.1					
	C	10.3	9.4	11.5	9.0	5.0	0.42	0.84	0.67	0.92	No No
	D	9.9	10.2	10.3	9.2	5.0					Main: <u>A B C D</u> Sub: <u>N₁ NP NPK N₂</u>
Mean of Sub-treatments											
		5.3	5.0	5.3	5.0						

[illegible]

Sulgode Estate, Sakalaspur Zone. Spacing: 5' x 5'. Replications: 3.

1957	A	10.4	8.0	9.1	10.3	3.2	No	Main: CBDA	No	Sub: NP ₁ NPK ₂
B	10.3	11.9	13.9	11.0	3.9					
C	11.3	11.8	15.1	9.5	4.0	1.32	1.30	1.9		
D	10.6	10.0	10.3	11.3	3.5					

Mean of Sub-treatments 2.8 2.7 2.7 2.8

1957	A	20.0	21.5	20.9	21.8	4.2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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APPENDIX XLII (B)
Field Manurial Trials in Private Estates—Arabica

Yield of cherry expressed as percentage of the means of N₁ and N₂

Treatments	Merthi- khan	Urvin- khan	Sulgode	Karadi- betta	Bynecool	Togari- hankal	Vasam- badi	Manuva- halla	C.R.S.S.	Mean of 9 estates
A. 40 lb. N ₂ , N	100	100	100	100	100	100	100	100	100	100
40 „ „ NP	111	92.5	104.5	129.3	103.0	106.3	143.0	102.5	98.2	110
40 „ „ NPK	66.5	105.6	120.0	94.0	133.7	92.5	85.3	83.0	104.5	100.6
B. 60 lb. N ₂ , N	100	100	100	100	100	100	100	100	100	100
60 „ „ NP	103.8	127.3	104.0	94.0	123.0	93.3	144.0	115.4	130.6	115.0
60 „ „ NPK	110.7	99.6	91.2	113.0	98.6	120.8	118.2	70.8	117.6	104.5
C. 80 lb. N ₂ , N	100	100	100	100	100	100	100	100	100	100
80 „ „ NP	171.0	127.2	83.0	107.1	97.2	87.6	78.7	97.6	103.7	106
80 „ „ NPK	80.5	99.4	100	100	75.0	89.0	98.3	116.5	111.4	96.7
D. 100 lb. N ₂ , N	100	100	100	100	100	100	100	100	100	100
100 „ „ NP	98.3	102.5	106.8	125.6	91.6	90.8	109.3	102.0	125.9	105.9
100 „ „ NPK	101.3	91.8	94.8	115.2	57.6	80.1	91.1	70.3	126.8	92.0

Robusta Field Manurial Trials in Private Estates—Yield Data

Treatments Main: 4, Sub: 4. Lay-out: Randomized Split Plot.
No. of Plants per Sub-Plot: Gross: $7 \times 6 = 42$. Nett: $5 \times 4 = 20$.

Shade: Natural mixed shade. Started: 1955.

Main Treatments:

A.	Nitrogen at 40 lb. to the acre per annum.
B.	60 "
C.	80 "
D.	100 "

Sub-Treatments:

- N_1 : The required quantity of nitrogen applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.
 N_2 : The required quantity of nitrogen applied in three doses; once in the pre-blossom, once in the pre-monsoon and once in the post-monsoon season.
 NP: The required quantity of nitrogen applied as above (N_2) + 30 lb. Phosphoric acid to the acre applied in two doses once in pre-blossom and once in the post-monsoon season.
 NPK: As in NP above + 40 lb. Potash to the acre applied in two equal doses once in pre-blossom and once in the post-monsoon season.

Main Treatments	Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treat- ments	Standard error		Critical differ- ence $P = 0.05$		Significant or not		Conclusions	
	Sub-treatments					Main Plots	Sub- Plots	Main treat- ments	Sub- treat- ments	Main treat- ments	Sub- treat- ments		
	N ₁	N ₂	NP	NPK									
Sulgoode Estate, Sakalespur Zone, Mysore. Spacing: 10'×10'. Replications: 3.													
1957	A	28.6	28.0	28.8	30.5	9.7							
	B	18.0	24.5	22.2	29.8	7.9							
	C	37.8	20.5	24.9	28.2	9.3	1.97	2.53	1.97	2.13	No	No	Main: $\overline{D A C B}$
	D	25.6	37.7	27.6	29.8	10.1							Sub: $\overline{NPK N_2 N_1 NP}$
Mean of Sub-treatments 9.2 9.2 8.6 9.9													
1958	A	57.4	51.1	55.2	51.9	18.0							
	B	51.0	54.9	52.9	53.5	17.7							
	C	45.4	50.8	60.0	55.8	17.5	2.47	2.71	2.47	2.28	No	No	Main: $\overline{D A B C}$
	D	55.1	54.9	65.0	69.6	20.4							Sub: $\overline{NP NPK N_2 N_1}$
Mean of Sub-treatments 17.4 17.6 19.4 19.2													

APPENDIX XLIII (Contd.)

Main Treatments	Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treat- ments	Standard error		Critical differ- ence P = 0.05		Significant or not	Conclusions
	Sub-Treatments					Main Plots	Sub- Plots	Main treat- ments	Sub- treat- ments		
	N ₁	N ₂	NP	NPK							
<i>Chellote Estate, Kalpetta, Wynaad.</i> Spacing: 10' × 10'. Replications: 2.											
1957 A	4.9	4.2	4.0	5.6	2.3						
B	7.1	9.4	8.8	9.8	4.4						
C	5.9	6.2	5.8	8.3	3.3	1.26	0.74	1.62	0.65	No	Yes Main: <u>B D C A</u> Sub: <u>NPK NP N₂ N₁</u>
D	6.2	5.7	6.9	9.4	3.5						
Mean of Sub-treatments	3.0	3.2	3.2	4.1							
1958 A	8.9	10.6	12.9	13.7	5.8						
B	7.4	12.4	11.0	12.3	5.4						
C	8.9	8.1	7.1	12.3	4.6	1.79	1.52	2.84	1.65	No	No Main: <u>A B C D</u> Sub: <u>NPK NP N₂ N₁</u>
D	7.4	7.4	8.1	10.6	4.2						
Mean of Sub-treatments	4.1	4.8	4.9	6.1							
<i>North Carolina Estate, Kalpetta, Wynaad.</i> Spacing: Replications I and II 10' × 10'. Replications: III 9' × 9'. Replications 3.											
1957 A	25.6	22.1	17.4	28.0	7.8						
B	24.9	21.6	20.7	23.1	7.5						
C	31.0	18.6	22.6	22.8	7.9	4.33	1.66	4.33	1.40	No	Yes Main: <u>D C A B</u> Sub: <u>NPK N₁ N₂ NP</u>
D	24.4	28.9	24.5	38.9	9.7						
Mean of Sub-treatments	8.8	7.6	7.1	9.4							
1958 A	11.9	12.0	9.5	14.9	4.0						
B	11.4	10.0	10.0	13.9	3.8						
C	16.1	12.5	15.0	19.2	5.2	2.26	1.53	2.26	1.30	No	Yes Main: <u>D C A B</u> Sub: <u>NPK N₁ NP N₂</u>
D	18.7	14.8	16.1	21.6	5.9						
Mean of Sub-treatments	4.8	4.1	4.2	5.8							

APPENDIX XLIV

*Modified Robusta Manurial Trials laid out in Private Estates—Yield Data for 1957-1958—Series I**Lay-out:* Latin Square.*Treatments:* 6.*Replications:* 6.*Shade:* Natural mixed shade.*Started:* 1956.*No. of Plants per Sub-Plot:* Nett; $5 \times 4 = 20$ with one common border row on either side and between each successive pair of sub-plots and a common guard row all round the plot.*Treatments:*

A	40 lb. nitrogen	+ 30 lb. Phosphoric acid	+ 40 lb. Potash to the acre per annum.
B	60 "	"	"
C	60 "	+ 45 "	"
D	80 "	+ 60 "	"
E	60 "	+ 60 "	"
F	40 "	+ 60 "	"

A basal dressing of 10 cwt. of finely ground Rock Phosphate is applied broadcast and stirred into the top soil soon after marking out the plots at the commencement of the trial.

Time of Application of Fertilizers:

Nitrogen applied in three doses once in the pre-blossom, once in the post-blossom and once in the post-monsoon period. Phosphoric acid and Potash applied in two doses once in the pre-blossom and once in the post-monsoon period.

Name of the Estates	Average yield of ripe cherry in lb. calculated to the acre						Standard error as % of difference gen. mean	Critical P=0.05	Significant or not	Conclusions
	Treatments									
	A	B	C	D	E	F				
1. Cheekanhally Estate, Sakalasapur	3719	2730	3010	2342	2955	3120	14.13	1231	No	<u>A F C E B D</u>
2. Harley Estate, Sakalasapur ..	1330	2552	2208	2040	2146	2267	49.71	1292	No	<u>B F C E D A</u>
3. Panchura Estate, Kalpetta, Wynaad	2106	2496	2671	2205	2496	2944	67.28	2174	No	<u>F C B E D A</u>
4. Maniancode Estate, Kalpetta, Wynaad	2843	3118	3409	3134	3391	2989	9.46	875	No	<u>C E D B F A</u>
5. Huvinakadu Estate, South Coorg	4906	3281	3075	3428	2864	3922	16.34	702	Yes	<u>A F D B C E</u>
6. Yemmegundi Estate, South Coorg	2015	1656	2036	1722	1969	1832	17.32	959	No	<u>C A E F D B</u>
7. Bankal Estate, Mudegere ..	3983	3756	2872	3418	3054	3347	29.78	1203	No	<u>A B D F E C</u>
Mean of 7 Estates ..	2986	2655	2755	2613	2696	3013				

Modified Robusta Manurial Trials laid out in Private Estates—Yield Data for 1957-58—Series II

Lay-out: Latin Square. *Treatments:* 6. *Replications:* 6. *Shade:* Natural mixed shade. *Started:* 1956.
No. of plants per Sub-plot: Nett: $5 \times 4 = 20$ with one common border row on either side and between each successive pair of sub-plots
 and a common guard row all round the plot.

Treatments:

- A. Nitrogen only at 60 lb. to the acre applied as Ammonium sulphate.
- B. Nitrogen at 60 lb. to the acre + 45 lb. P_2O_5 to the acre applied as Hyper Phosphate Reno.
- C. Nitrogen as in (A) above + 60 lb. Potash to the acre applied as Muriate of Potash.
- D. Phosphoric acid at 45 lb. to the acre + 60 lb. Potash to the acre applied as Hyper Phosphate Reno and Muriate of Potash respectively.
- E. As in treatment (B) above + 60 lb. Potash to the acre applied as Muriate of Potash.
- F. Control—No treatment.

A basal dressing of 10 cwt. of finely ground agricultural limestone is to be applied broadcast and stirred into the top soil soon after marking out the plots during the commencement of the trial.

Time of application of fertilizers:

Nitrogen applied in three doses; once in the pre-blossom, once in the post-blossom and once in the post-monsoon period. Phosphoric-acid and Potash applied in two doses once in the pre-blossom and once in the post-monsoon period.

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Name of the Estates	Average yield of ripe cherry in lb. calculated to the acre						Standard error as % of gen. mean	Critical difference P=0.05	Signifi- cant or not	Conclusions
	Treatments									
	A	B	C	D	E	F				
	N	NP	NK	PK	NPK	Control				
1. Cheekanhally Estate, Sakalasapur 4108		2649	2975	3576	4056	3345	13.5	972	Yes	<u>A E D F</u> C B
2. Harley Estate, Sakalasapur .. 1861		2414	1966	2150	2095	1769	30.97	782	No	<u>B D E C A F</u>
3. Panchura Estate, Kalpetta, Wynaad .. 2286		1383	2495	3732	2822	2891	17.92	1380	Yes	<u>D F E C A B</u>
4. Maniancode Estate, Kalpetta, Wynaad .. 3255		3546	3227	4148	4511	2724	22.14	952	Yes	<u>E D B A C F</u>
5. Bankal Estate, Mudgere .. 2188		2660	2496	2088	2311	1871	17.09	461	Yes	<u>B C E A D F</u>
Mean of 5 Estates .. 2740		2530	2632	3139	3159	2520				

APPENDIX XLVI (A)

Exploratory Trial on the Effect of Foliar Applications of Plant Foods to Coffee in Relation to Growth and Yield of Coffee—Yield Record

Lay-out: Simple randomized. *Treatments:* 10. *Replications:* 3. *Started in:* 1956. Single plant constitutes a sub-plot.
Shade: Natural mixed shade.

Treatments:

- A. 20 lb. Nitrogen per acre—sprayed as urea solutions (N_1). F. As in Treatment B + 40 lb. K_2O applied as above (N_2K_2).
 B. 40 lb. Nitrogen per acre—sprayed as urea solutions (N_2). G. As in Treatment C + 20 lb. K_2O applied as above ($N_1P_1K_1$).
 C. As in Treatment A + 15 lb. P_2O_5 sprayed as superphosphate H. As in Treatment D + 40 lb. K_2O applied as above ($N_2P_2K_2$).
 dispersion N_1P_1 I. No treatment — Control ($N_0P_0K_0$).
 D. As in treatment B = 30 lb. P_2O_5 applied as above (N_2P_2) J. Plain water used for the above solutions ($N_0P_0K_0$).
 E. As in Treatment A + 20 lb. K_2O sprayed as Muriate of potash solution (N_1K_1).

Year and Particulars	Yield of ripe cherry in lb. and clean coffee in oz. per plant										Standard error as % of gen. mean	Critical difference $P=0.05$	Significant or not	Conclusions
	Treatments													
	A	B	C	D	E	F	G	H	I	J				
1957 Ripe Cherry ..	4.5	5.2	4.7	6.8	7.0	3.2	4.1	4.0	7.5	5.3	24.50	3.80	No	I E D J B C A G H F
1958 Ripe Cherry	4.1	1.8	4.4	4.0	7.0	9.3	6.5	4.6	2.1	6.1	43.63	6.40	No	F E G J H C A D I B
1957 Clean Coffee..	13.0	16.0	14.0	20.7	20.3	9.3	13.3	12.7	22.3	15.3	25.83	11.97	No	I D E B J C G A H F
1958 Clean Coffee	10.2	5.1	12.3	11.4	19.5	27.7	19.0	10.3	6.1	17.7	49.37	20.56	No	F E G J C D H A I B

APPENDIX XLVI (B)

Exploratory Trial on the Effect of Foliar Applications of Plant Foods to Coffee in Relation to Growth and Yield—Blossom to Berry Observations, 1957-58
(Details of the Experiment given in Appendix)

Replications	Percentage of fruit set in each plot										Standard error as % of general mean	Critical difference cant or not P=0.05	Conclusions	
	Treatments													
	A	B	C	D	E	F	G	H	I	J				
I	28.5	43.6	33.3	22.1	50.9	43.9	29.7	51.0	46.8	16.3	15.86	17.44	No	<u>F I E H A D J G B C</u>
II	44.0	44.6	36.0	38.5	45.4	44.1	29.9	41.1	27.4	46.0				
III	34.3	9.6	15.2	41.7	35.2	45.0	38.7	31.8	38.8	36.8				
Mean	35.60	32.60	28.17	34.10	43.83	44.33	32.77	41.30	44.33	33.03				

APPENDIX XLVII

Studies to find out the Maximum Utilizable Dose of Nitrogen by Young Coffee Seedlings, With and Without the Addition of Phosphorous and Potassium

Lay-out: Randomized. **Treatments:** Main: 6; Sub.: 2. **Replications:** 3. **Started:** March 1957.

Plot Size: Each plot consisting of 110 seedlings planted 5' apart in 5 rows of 21 seedlings each, is divided into 2 sub-plots consisting of 50 seedlings each with the middle row of 5 seedlings forming a common border row.

Main Treatments:

N_0 = 0 lb., nitrogen to 1,200 seedlings in 20 applications.

N_1 = 12 "	"	"	1,200	"	20	"
N_2 = 24 "	"	"	1,200	"	20	"
N_3 = 48 "	"	"	1,200	"	20	"
N_4 = 96 "	"	"	1,200	"	20	"
N_5 = 192 "	"	"	1,200	"	20	"

Sub-Treatments:

Each plot receiving a main treatment is split into 2 halves with one half receiving Phosphorous and Potassium also according to the following scheme:—

$N_0 + P_0$ 0 lb. $P_2O_5 + K_0$ 0 lb. K_2O to 1,200 seedlings in 20 applications.
$N_1 + P_1$ $7\frac{1}{2}$ lb. $P_2O_5 + K_1$ 12 lb. K_2O to 1,200 seedlings in 20 applications.
$N_2 + P_2$ 15 lb. $P_2O_5 + K_2$ 24 lb. K_2O to 1,200 seedlings in 20 applications.
$N_3 + P_3$ 30 lb. $P_2O_5 + K_3$ 48 lb. K_2O to 1,200 seedlings in 20 applications.
$N_4 + P_4$ 60 lb. $P_2O_5 + K_4$ 96 lb. K_2O to 1,200 seedlings in 20 applications.
$N_5 + K_5$ 120 lb. $P_2O_5 + K_5$ 192 lb. K_2O to 1,200 seedlings in 20 applications.

Time and mode of application of treatments:

Nitrogen in the form of Urea, Phosphorus in the form of Hyper Phosphate Reno and Potash in the form of Muriate of Potash are being used to supply the plant nutrients. The required quantities of fertilizers are applied dispersed/dissolved in water once a fortnight. An equal quantity of water is applied to the Control plots.

Growth Measurements—Data

Sub-Treatments	Increase in the height of seedlings in cm. (totals of 3 replications)						Mean of Sub- treat- ments	Standard error		Critical difference P=0.05		Significant or not	Conclusions	
	Main Treatments							Main Plots	Sub- Plots	Main treat- ments	Sub- treat- ments			
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅								
<i>Growth measurements recorded in the Laboratory</i>														
N ..	308.9	288.4	251.8	220.9	205.5	184.3	81.1						Main : $\overline{N_0 N_1 N_2 N_3 N_4 N_5}$	
NPK ..	332.6	278.5	241.7	223.0	168.3	165.5	78.3	13.2	1.82	17.0	1.3	Yes	Yes	
Mean of Main treat- ments	106.9	94.5	82.3	74.0	62.3	58.3								
<i>Growth measurements in the field</i>														
N ..	240.6	204.1	184.5	192.0	150.4	..	64.8						Main : $\overline{N_0 N_1 N_2 N_3 N_4}$	
NPK ..	234.0	201.0	194.8	177.9	142.4	..	63.4	5.2	6.08	6.9	4.9	Yes	No	
Mean of Main treat- ments	79.1	67.5	63.2	61.7	48.8								Sub : $\overline{N}$ NPK	

Lay-out: Simple randomized.
Single plant constitutes a sub-plot.

Treatments:

- 1. Duraset 20-W 4 lb. in 100 gallons of water.
- 2. " " 1 lb. in 100 gallons of water.
- 3. " " 2 lb. in 100 gallons of water.
- 4. " " 0.13 lb. in 100 lb. Talc.
- 5. " " 0.26 lb. in 100 lb. Talc.
- 6. " " 0.52 " in 100 lb. Talc.

Treatments: 9 x 3 = 27.
Shade: Natural mixed shade.

Replications: 3.
Started: 1956.

- A. } Solutions sprayed
- B. } to give full coverage
- C. } of plants.
- D. } Dusted to give
- E. } full coverage of
- F. } plants.
- 7. Plain water used for making above solutions, sprayed.
- 8. Plain Talc. used for making above dusts dusted.
- 9. Control—No treatments

G.
H.
I.

Time of Application:

One set of the above treatments given before blossom. One set on the blossom and One set at petal fall.

Year and Particulars	Average yield of ripe cherry in lb. per plant										Standard error as % as gen. mean	Critical difference P=0.05	Significant or not	Conclusions
	Treatments													
	A	B	C	D	E	F	G	H	I					
<i>Arabica</i> —1957														
1st Set before Blossom	..	3.3	1.5	3.0	2.5	3.0	3.7	5.4	2.0	3.5	20.43	1.9	Yes	<u>GFIACEDHB</u>
2nd Set on the Blossom	..	2.0	2.1	4.0	3.4	2.7	3.3	4.4	2.8	3.0	33.77	3.1	No	<u>GCDFIHEBA</u>
3rd Set at petal-fall	..	5.1	2.8	2.5	4.1	3.4	2.7	3.6	1.7	2.3	29.42	2.8	No	<u>ADGEBFTCH</u>
1958														
1st Set before Blossom	..	1.5	2.6	1.8	1.3	4.9	3.3	2.2	4.3	2.5	32.27	2.7	No	<u>EHFBIGCAD</u>
2nd Set on the Blossom	..	3.6	1.9	3.6	3.5	3.7	3.3	2.9	2.7	2.5	38.81	3.5	No	<u>ECADFGHIB</u>
3rd Set at petal-fall	..	4.3	2.2	3.3	3.7	3.9	1.6	0.9	3.2	3.5	50.14	4.5	No	<u>AEDICHBBFG</u>
<i>Robusta</i>														
1957														
1st Set before Blossom	..	2.1	2.0	0.7	0.8	4.6	2.9	2.0	0.7	0.8	50.19	2.8	No	<u>EFAGRIDHC</u>
2nd Set on the Blossom	..	2.3	1.3	2.7	0.7	1.3	3.3	3.5	2.6	0.9	48.14	3.0	No	<u>GFCHAEIBD</u>
3rd Set at petal-fall	..	2.7	1.7	1.4	2.6	1.5	1.0	2.7	1.1	1.6	42.93	2.3	No	<u>AGDBIECHF</u>
1958														
1st Set before Blossom	..	6.0	7.8	6.4	9.0	5.5	9.1	8.7	16.3	7.0	32.11	8.1	No	<u>HFDBGITCAE</u>
2nd Set on the Blossom	..	8.3	5.7	6.3	7.8	7.9	7.8	6.8	7.9	8.1	28.23	6.3	No	<u>AI EHDFGCB</u>
3rd Set at petal-fall	..	5.5	7.4	8.4	8.4	5.5	9.7	7.3	7.9	5.9	32.47	7.1	No	<u>FCDHBBGIAE</u>

APPENDIX XLIX (A)
Mechanical Analysis of Soil Samples Collected under Different Shade Trees

Description	Moisture %			Silt %			Clay %			Fine fraction %		
	May	Nov.	May	May	Nov.	May	May	Nov.	May	May	Nov.	May
1. <i>Albizzia stipulata</i> Soil 0-6"	8.820	7.936	6.630	9.083	8.333	9.571	36.683	33.463	32.473	45.767	41.762	42.040
2. <i>Artocarpus integra</i> do.	6.763	8.410	5.964	8.250	6.353	11.063	25.733	28.348	29.519	33.983	34.701	40.583
3. <i>Bischofia javanica</i> do.	8.986	7.825	7.049	9.250	11.880	10.849	37.797	30.157	32.893	47.013	42.037	43.742
4. <i>Erythrina lithosperma</i> do.	9.267	7.968	7.579	9.083	13.118	14.046	31.983	33.215	31.701	41.069	46.333	45.747
5. <i>Grevillea robusta</i> do.	7.200	7.743	6.495	7.583	7.673	9.908	31.067	32.308	28.216	38.650	39.980	38.124
6. <i>Ficus glomerata</i> do.	7.840	9.865	6.135	10.000	11.121	8.660	29.233	23.728	22.193	39.223	34.789	30.853

Description of shade trees as above	Fine sand %			Coarse sand %			Coarse fraction %			Coarse fraction/ Fine fraction			Loss by solution		
	May	Nov.	May	May	Nov.	May	May	Nov.	May	May	Nov.	May	May	Nov.	May
1.	17.645	19.513	20.225	20.638	20.967	20.587	38.616	40.480	40.812	0.865*	0.996	0.978	6.797	9.789	10.515
2.	24.802	22.685	25.325	23.010	18.109	16.387	47.812	40.794	41.772	1.441	1.328	0.187	11.342	16.095	11.682
3.	17.379	18.815	18.573	15.631	18.460	14.953	33.010	37.275	33.526	0.718	0.896	0.780	10.987	12.863	15.687
4.	16.962	17.307	14.060	15.198	14.918	12.744	32.160	32.225	27.304	0.931	0.797	0.525	14.73	13.474	18.890
5.	20.243	21.146	19.550	23.932	21.598	23.278	44.140	42.745	43.278	1.193	1.088	1.183	9.978	9.531	12.104
6.	18.043	24.372	19.651	17.052	18.065	20.078	35.095	42.436	39.729	0.939	1.332	1.569	17.831	12.849	23.283

APPENDIX XLIX (B)

Chemical Analysis of Soil Samples Collected under Different Shade Trees

Description	Loss on ignition expressed in percentage													
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	
1. <i>Albizia stipulata</i>	8.82	10.37	9.71	9.57	8.48	9.28	9.90	9.48	10.20	9.71	10.49	9.73	9.91	
2. <i>Artocarpus integra</i>	9.52	9.50	9.23	8.61	10.35	9.05	9.82	9.85	11.85	9.10	9.26	7.41	10.61	
3. <i>Bischofia javanica</i>	7.91	11.77	12.87	9.91	11.82	10.89	11.92	10.00	12.22	10.70	10.81	9.16	11.91	
4. <i>Erythrina lithosperma</i>	10.35	11.25	9.65	11.06	9.25	10.22	9.32	10.48	12.00	9.73	9.61	9.31	10.13	
5. <i>Grevillea robusta</i>	8.77	7.70	9.11	9.83	10.24	8.92	7.42	8.15	11.81	10.03	9.60	8.34	9.97	
6. <i>Ficus glomerata</i>	10.64	8.65	11.32	9.19	9.34	11.09	7.63	10.13	11.47	9.76	9.45	8.39	8.87	
pH determination														
1. <i>Albizia stipulata</i>	6.4	6.1	5.9	5.9	6.2	6.1	6.2	6.1	6.3	5.7	5.7	5.7	6.3	
2. <i>Artocarpus integra</i>	6.1	6.3	6.2	6.0	6.0	5.9	6.0	6.0	6.3	5.9	5.8	5.9	6.0	
3. <i>Bischofia javanica</i>	6.2	6.4	6.2	6.1	5.9	5.9	5.9	5.9	6.4	6.1	6.1	6.2	6.1	
4. <i>Erythrina lithosperma</i>	6.3	6.2	6.2	6.2	5.7	5.9	6.0	6.0	6.3	6.0	6.0	6.0	6.2	
5. <i>Grevillea robusta</i>	6.2	6.1	6.1	5.8	5.7	6.0	6.0	5.9	6.4	6.2	6.0	6.2	6.5	
6. <i>Ficus glomerata</i>	6.1	6.4	6.3	6.2	5.7	6.0	6.0	5.9	6.4	6.2	5.8	5.8	6.2	

APPENDIX XLIX (B) (Contd.)

Description of shade trees	Analytical data expressed as on oven-dry basis															
	Total P ₂ O ₅ %			Total K ₂ O %			Total CaO %			Total MgO %			Total Fe ₂ O ₃ %			
	May	Nov.	May	May	Nov.	May	May	Nov.	May	May	Nov.	May	May	Nov.	May	
1. <i>Albizzia stipulata</i> Soil 0-6"	..	0.190	0.298	0.242	0.298	0.428	0.425	0.270	0.538	0.517	0.381	0.404	0.451	7.04	7.92	6.90
2. <i>Artocarpus integra</i> Soil 0-6"	..	0.146	0.287	0.312	0.222	0.463	0.312	0.264	0.493	0.456	0.281	0.339	0.270	8.71	8.38	7.90
3. <i>Bischofia javanica</i> Soil 0-6"	..	0.140	0.247	0.269	0.312	0.537	0.334	0.386	0.609	0.454	0.289	0.308	0.369	8.10	10.74	9.46
4. <i>Erythrina lithosprma</i> Soil 0-6"	..	0.159	0.312	0.285	0.301	0.409	0.340	0.527	0.467	0.464	0.370	0.366	0.275	9.02	11.58	11.86
5. <i>Grevillea robusta</i> Soil 0-6"	..	0.111	0.151	0.199	0.273	0.285	0.290	0.171	0.429	0.388	0.431	0.480	0.463	7.02	9.35	7.30
6. <i>Ficus glomerata</i> Soil 0-6"	..	0.115	0.316	0.269	0.329	0.304	0.321	0.399	0.479	0.539	0.547	0.526	0.506	6.10	6.06	7.66

Description of shade trees	Total Nitrogen percentage expressed on oven-dry basis													
	Organic Carbon expressed on oven-dry basis													
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	May
1. <i>Albizzia stipulata</i> Soil 0-6"	..	0.239	0.250	0.245	0.289	0.262	0.267	0.303	0.244	0.200	0.256	0.266	0.233	0.303
2. <i>Artocarpus integra</i> do.	..	0.213	0.205	0.245	0.248	0.257	0.230	0.212	0.246	0.246	0.224	0.261	0.224	0.244
3. <i>Bischofia javanica</i> do.	..	0.266	0.253	0.224	0.301	0.306	0.289	0.263	0.230	0.277	0.270	0.272	0.248	0.292
4. <i>Erythrina lithosperma</i> do.	..	0.213	0.278	0.240	0.279	0.289	0.299	0.258	0.219	0.263	0.252	0.238	0.245	0.270
5. <i>Grevillea robusta</i> do.	..	0.219	0.194	0.307	0.280	0.265	0.259	0.237	0.200	0.287	0.233	0.274	0.269	0.296
6. <i>Ficus glomerata</i> do.	..	0.245	0.299	0.349	0.343	0.309	0.351	0.340	0.236	0.255	0.311	0.309	0.301	0.284

Description of shade trees	Organic Carbon expressed on oven-dry basis													
	Organic Carbon expressed on oven-dry basis													
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	May
1. <i>Albizzia stipulata</i> do.	..	3.13	3.25	2.00	2.94	2.86	2.77	3.01	3.21	2.79	3.25	2.98	2.03	3.16
2. <i>Artocarpus integra</i> do.	..	3.20	3.11	3.02	2.71	2.58	2.65	2.34	3.72	3.71	3.23	3.13	2.22	2.68
3. <i>Bischofia javanica</i> do.	..	3.36	3.53	2.82	3.51	3.13	3.06	3.12	3.52	3.82	3.70	3.20	2.70	2.52
4. <i>Erythrina lithosperma</i> do.	..	2.94	2.99	2.70	2.80	2.77	2.90	2.39	2.78	3.45	2.72	1.89	2.71	2.71
5. <i>Grevillea robusta</i> do.	..	2.79	2.73	2.96	3.16	3.47	3.07	2.68	2.73	3.29	2.98	3.30	2.69	2.71
6. <i>Ficus glomerata</i> do.	..	3.24	2.84	3.00	3.76	3.07	3.50	3.46	3.64	3.30	3.96	3.13	2.67	2.98

Carbon-Nitrogen ratio

1. <i>Albizia stipulata</i>	do.	..13-00	13-30	9-90	10-00	9-80	11-00	9-80	12-00	12-40	12-10	9-80	8-50	8-10
2. <i>Artocarpus integra</i>	do.	..15-00	15-00	12-30	11-00	9-00	10-20	11-30	15-80	13-90	12-60	12-20	9-90	8-60
3. <i>Bischofia javanica</i>	do.	..12-40	13-90	11-10	11-90	11-00	10-60	11-90	15-40	15-10	12-70	11-80	9-60	8-60
4. <i>Erythrina lithosperma</i>	do.	..12-00	10-90	11-50	10-20	10-50	11-10	9-20	12-70	14-20	10-60	11-50	7-50	8-20
5. <i>Grevillea robusta</i>	do.	..13-90	13-80	9-90	10-90	13-20	9-80	11-90	13-70	11-60	13-50	11-50	9-70	8-20
6. <i>Ficus glomerata</i>	do.	..13-80	14-22	8-40	10-90	10-70	10-10	9-20	14-40	12-20	11-60	9-50	9-30	10-50

Available P_2O_5 percentage

1. <i>Albizia stipulata</i>	Soil 0-6"	.. 0-0015	0-0022	0-0254	0-0148	0-0160	0-0164	0-0311	0-0043	0-0028	0-0094	0-0110	0-0024	0-0060
2. <i>Artocarpus integra</i>	do.	.. 0-0049	0-0060	0-0171	0-0080	0-0157	0-0096	0-0197	0-0013	0-0062	0-0065	0-0074	0-0102	0-0043
3. <i>Bischofia javanica</i>	do.	.. 0-0051	0-0286	0-0093	0-0244	0-0088	0-0118	0-0182	0-0012	0-0056	0-0090	0-0143	0-0131	0-0098
4. <i>Erythrina lithosperma</i>	do.	.. 0-0020	0-0016	0-0243	0-0194	0-0351	0-0218	0-0171	0-0049	0-0044	0-0089	0-0048	0-0062	0-0119
5. <i>Grevillea robusta</i>	do.	.. 0-0019	0-0041	0-0193	0-0120	0-0120	0-0101	0-0126	0-0008	0-0192	0-0073	0-0129	0-0063	0-0112
6. <i>Ficus glomerata</i>	do.	.. 0-0067	0-0046	0-0110	0-0144	0-0142	0-0132	0-0123	0-0360	0-0226	0-0121	0-0049	0-0183	0-0128

Available K_2O %

1. <i>Albizia stipulata</i>	do.	.. 0-0192	0-0183	0-0341	0-0272	0-0324	0-0244	0-0104	0-0139	0-0142	0-0165	0-0189	0-0186	0-0160
2. <i>Artocarpus integra</i>	do.	.. 0-0202	0-0231	0-0239	0-0220	0-0329	0-0149	0-0180	0-0076	0-0199	0-0279	0-0150	0-0202	0-0202
3. <i>Bischofia javanica</i>	do.	.. 0-0250	0-0304	0-0299	0-0203	0-0199	0-0379	0-0142	0-0136	0-0284	0-0245	0-0218	0-0208	0-0174
4. <i>Erythrina lithosperma</i>	do.	.. 0-0248	0-0238	0-0229	0-0212	0-0226	0-0269	0-0130	0-0178	0-0150	0-0141	0-0201	0-0227	0-0223
5. <i>Grevillea robusta</i>	do.	.. 0-0192	0-0184	0-0258	0-0205	0-0195	0-0247	0-0170	0-0196	0-0170	0-0274	0-0235	0-0255	0-0199
6. <i>Ficus glomerata</i>	do.	.. 0-0308	0-0314	0-0344	0-0247	0-0315	0-0289	0-0173	0-0199	0-0205	0-0245	0-0305	0-0323	0-0332

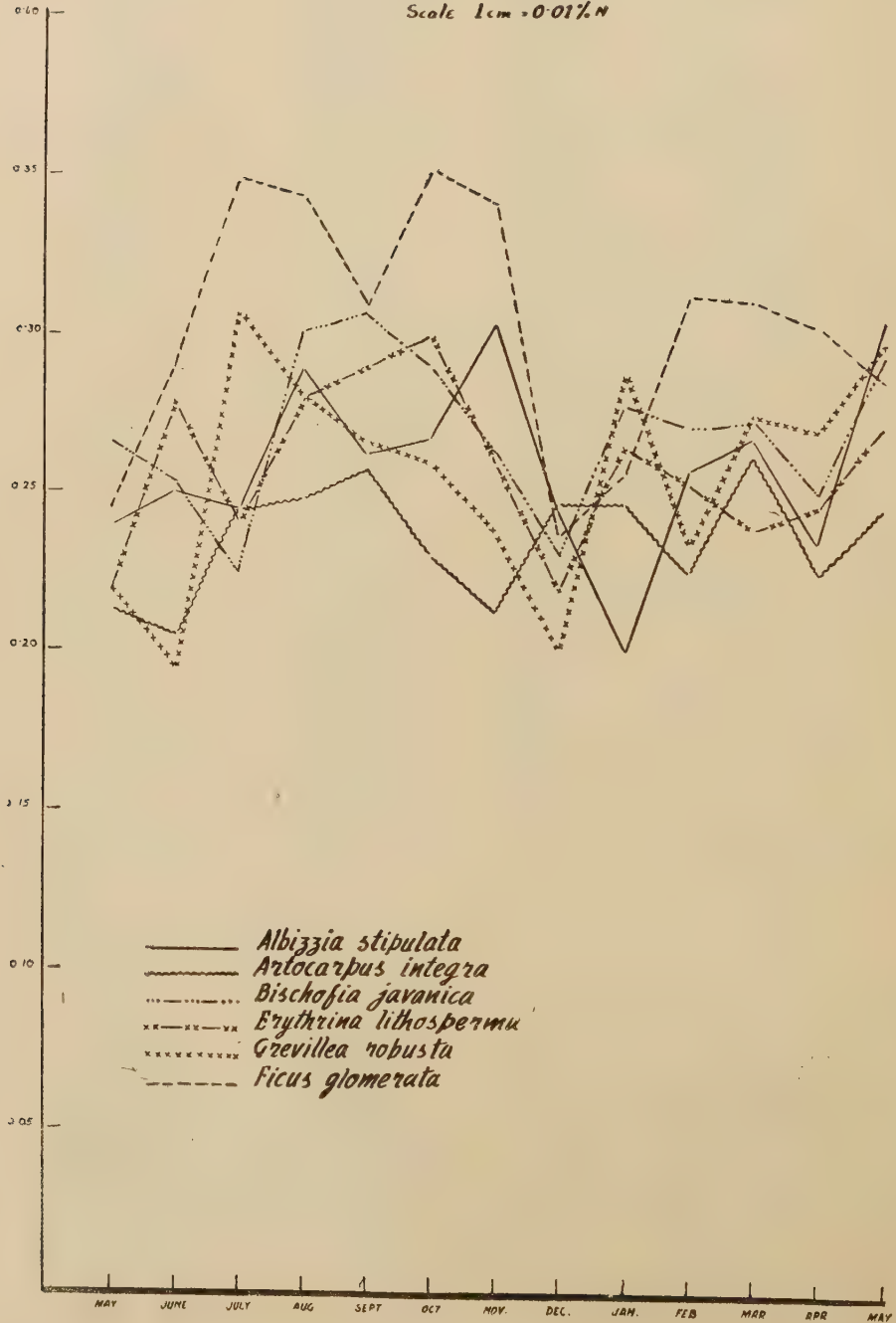
Total exchangeable bases

1. <i>Albizia stipulata</i>	do.	..15-16	11-81	7-57	7-61	7-94	8-63	11-21	12-03	8-96	10-16	8-67	9-63	12-78
2. <i>Artocarpus integra</i>	do.	..16-02	11-60	14-13	11-89	12-30	14-42	13-86	9-07	14-12	12-93	14-25	15-75	12-21
3. <i>Bischofia javanica</i>	do.	..21-89	15-47	12-00	12-29	11-84	10-31	13-61	16-74	16-85	19-47	19-36	18-27	15-67
4. <i>Erythrina lithosperma</i>	do.	..19-09	13-87	13-28	16-43	15-88	12-48	11-93	11-48	14-58	14-49	13-87	9-27	14-33
5. <i>Grevillea robusta</i>	do.	..13-61	8-10	15-45	12-67	11-49	9-26	11-40	12-12	16-05	17-83	19-87	18-19	14-62
6. <i>Ficus glomerata</i>	do.	..21-39	21-00	16-40	15-32	15-18	14-71	15-94	14-90	16-14	17-80	17-29	19-45	20-47

SEASONAL VARIATIONS IN AVAILABLE PLANT NUTRIENTS IN SOILS
UNDER DIFFERENT SHADE TREES

TOTAL NITROGEN

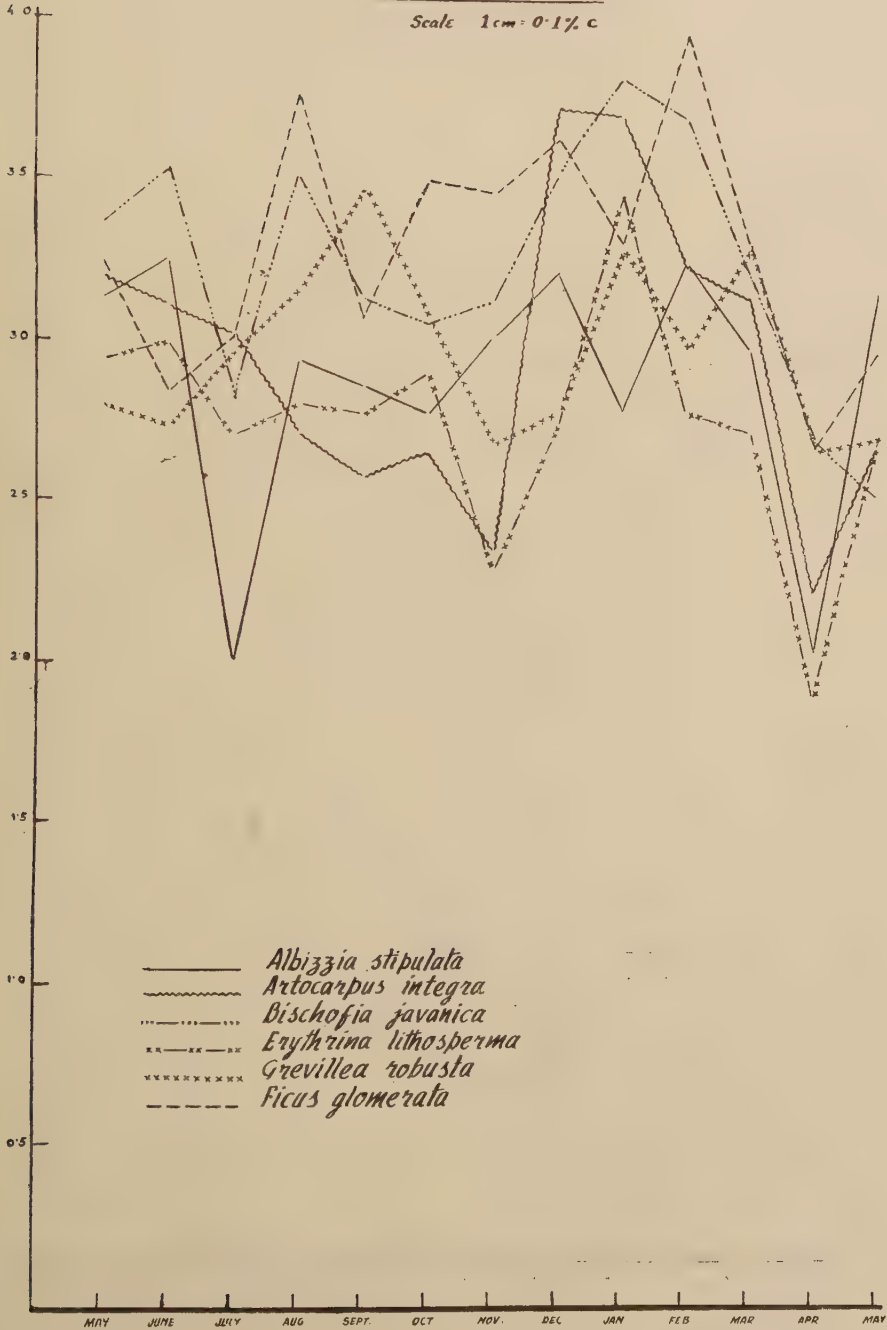
Scale 1 cm = 0.01% N



SEASONAL VARIATIONS IN AVAILABLE PLANT NUTRIENTS IN SOILS
UNDER DIFFERENT SHADE TREES

ORGANIC CARBON

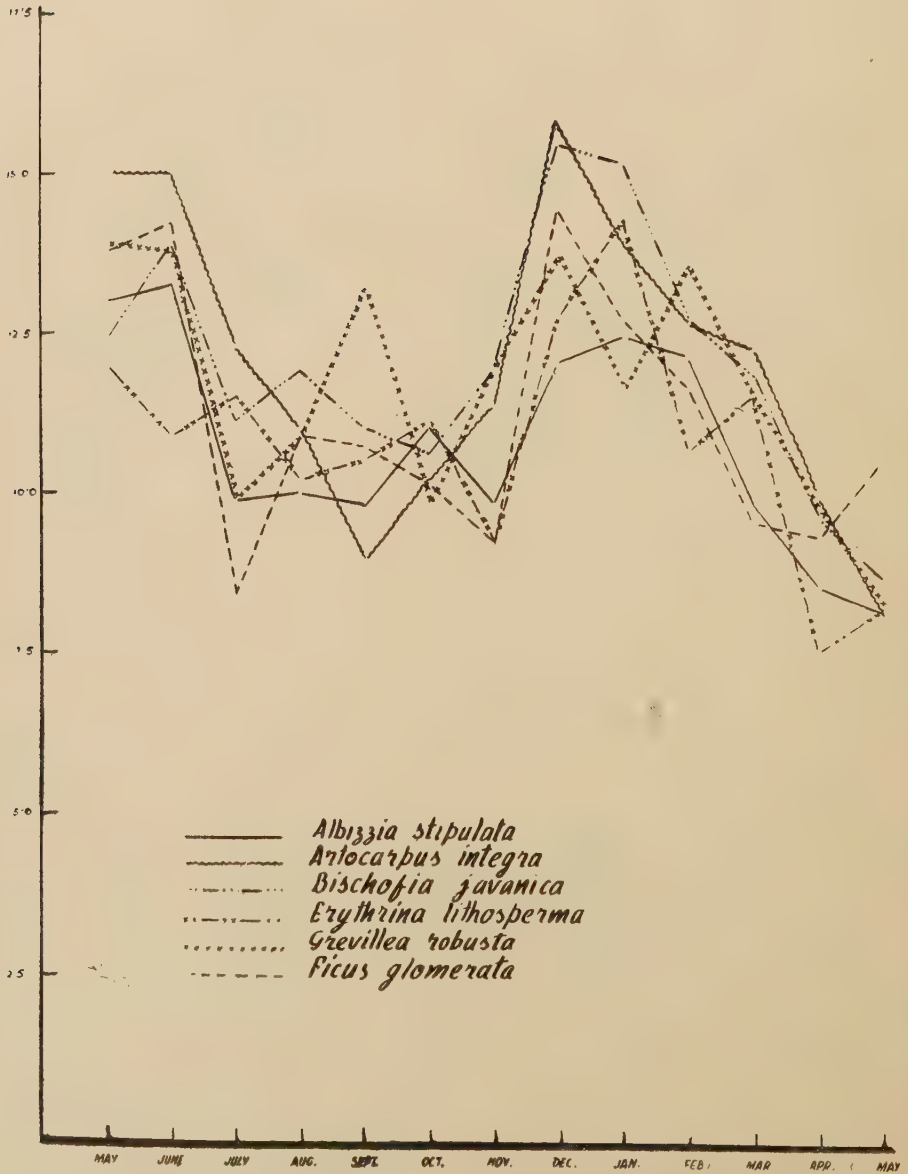
Scale 1 cm = 0.1% C



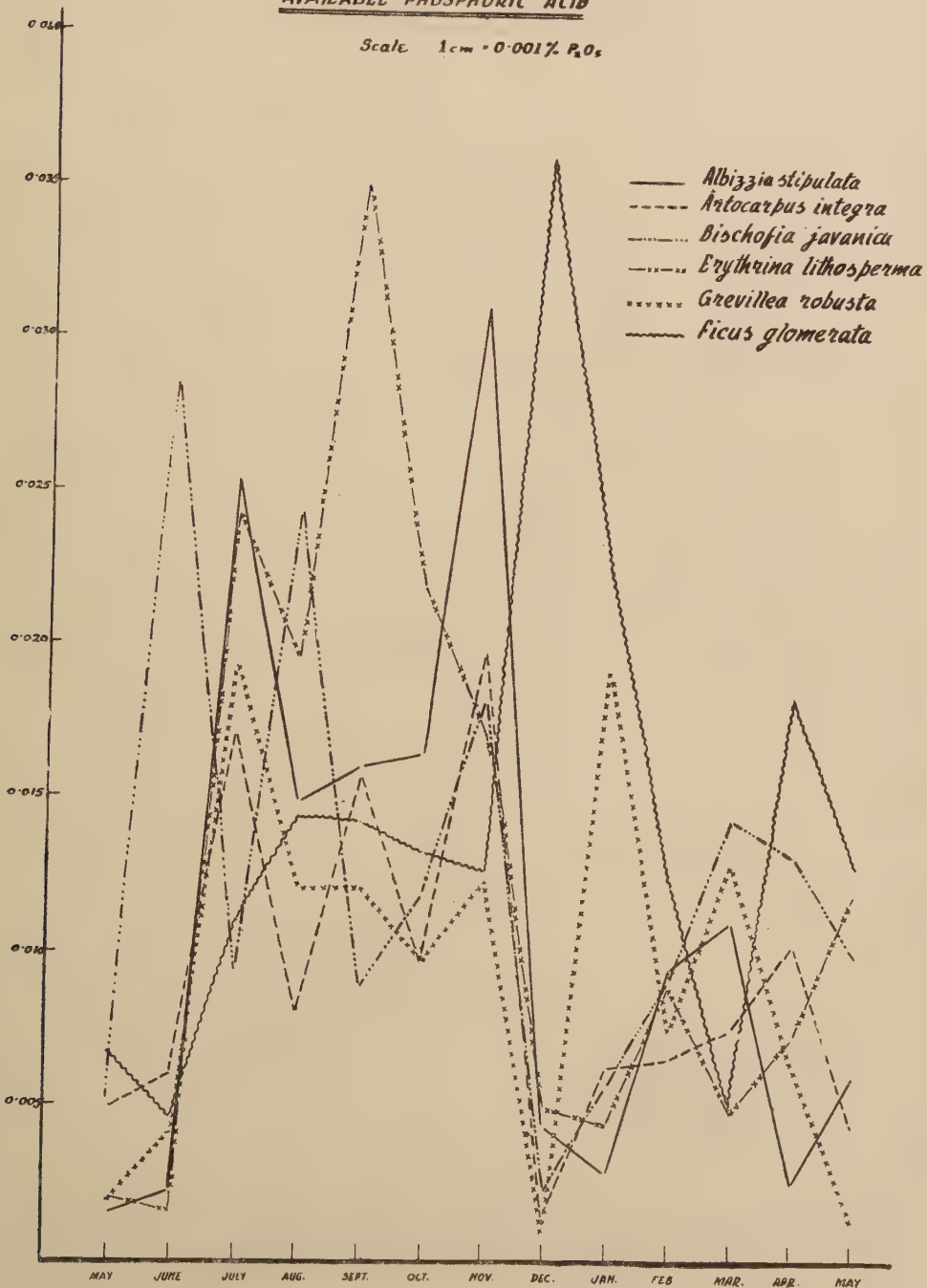
SEASONAL VARIATIONS IN AVAILABLE PLANT NUTRIENTS IN SOILS
UNDER DIFFERENT SHADE TREES

CARBON/NITROGEN RATIO

Scale 1 cm = 0.5



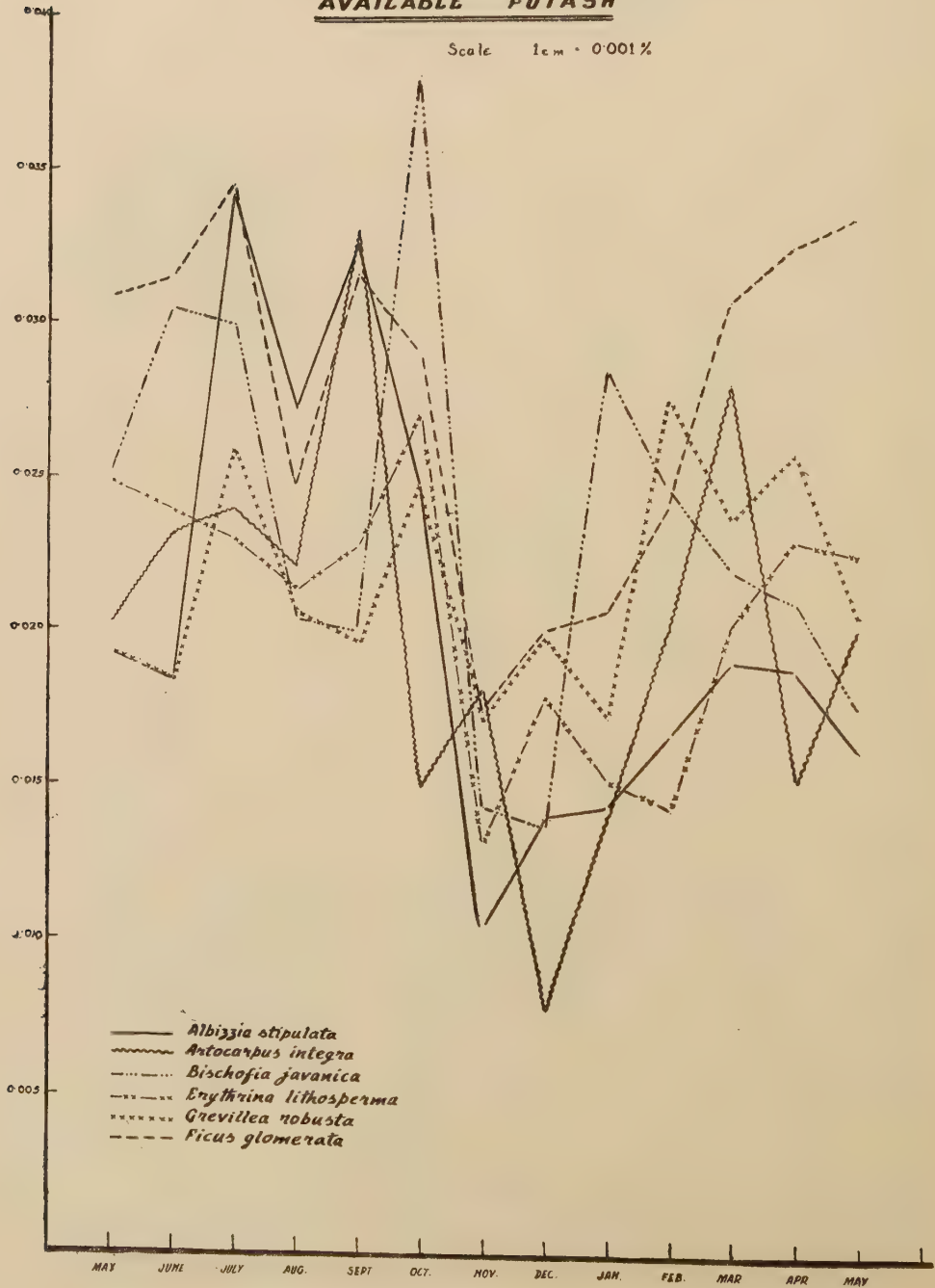
Scale 1 cm = 0.001% P_2O_5



SEASONAL VARIATIONS IN AVAILABLE PLANT NUTRIENTS IN SOILS UNDER DIFFERENT SHADE TREES

AVAILABLE POTASH

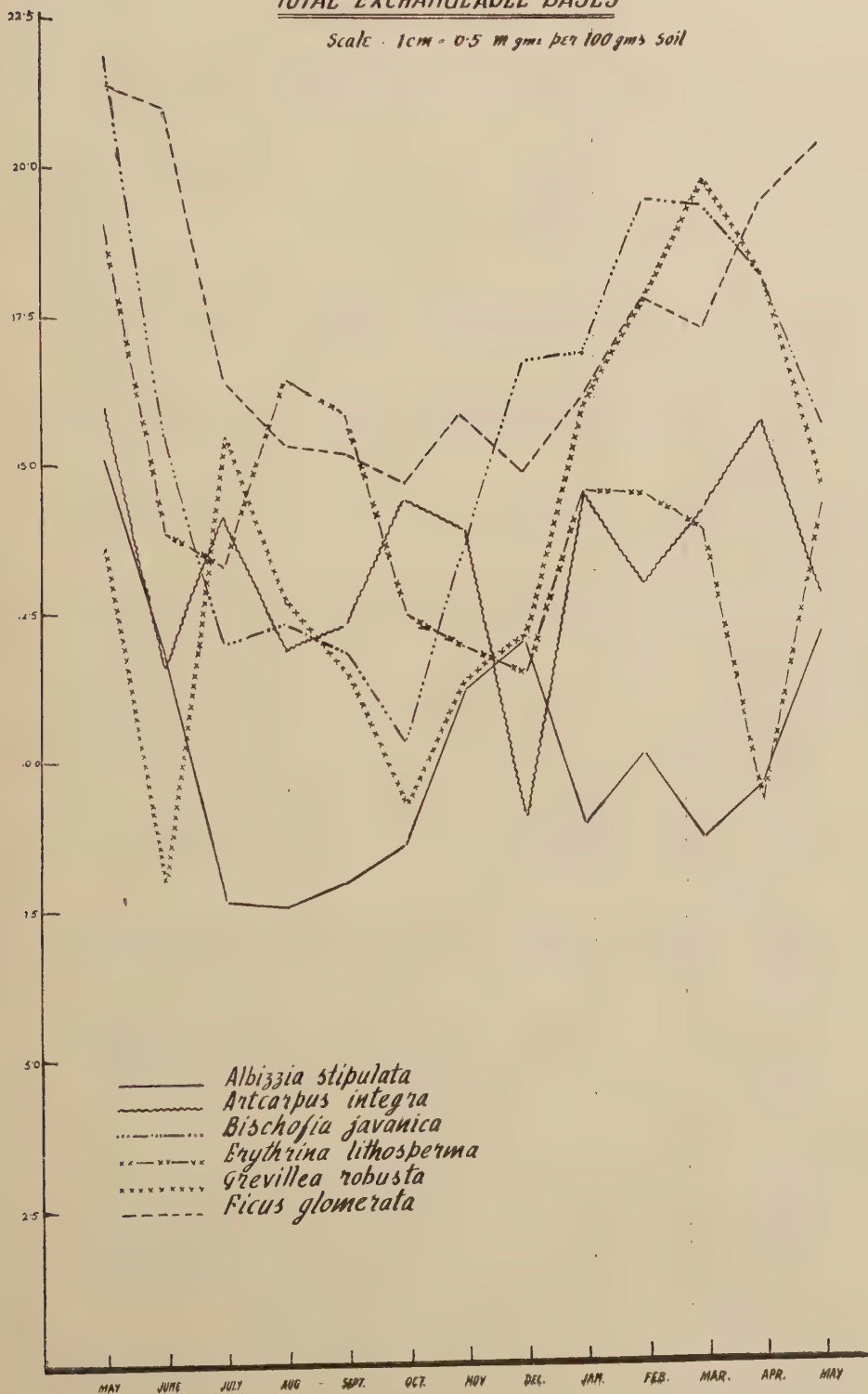
Scale 1 cm = 0.001 %



SEASONAL VARIATIONS IN AVAILABLE PLANT NUTRIENTS IN SOILS UNDER DIFFERENT SHADE TREES

TOTAL EXCHANGEABLE BASES

Scale : 1cm = 0.5 m gms per 100 gms soil



APPENDIX L

Exploratory Trial on the Effect of Foliar Applications of Plant Foods to Coffee in Relation to Growth and Yield

Analytical data of the leaf samples, Samples collected during May 1957. Percentage of Total P_2O_5 in young leaves. Values on moisture-free basis.

Treatments	I Replication				II Replication				III Replication				Average of 3 Replications	
	Before Treatment 2	After 24 hours 3	% Increase after 24 hours 4	Before Treatment 5	After 24 hours 6	% Increase after 24 hours 7	Before Treatment 8	After 24 hours 9	% Increase after 24 hours 10	% Increase after 24 hours 11				
1. N_1 ..	0.5421	0.6594	20.5	0.5809	0.8822	51.9	0.5934	0.7071	19.2	30.5				
2. N_2 ..	0.7600	0.8206	8.0	1.0001	0.7281	-27.2	0.5439	0.6892	26.7	2.5				
3. N_1P_1 ..	0.7094	0.9783	37.9	0.6898	0.8880	28.7	0.6838	0.8318	21.6	29.4				
4. N_2P_2 ..	0.7152	0.8986	25.6	0.5398	0.7550	39.9	0.5932	0.6763	14.0	29.8				
5. N_1K_1 ..	0.4769	0.6848	43.7	0.6291	0.7169	14.0	0.5520	0.7633	38.3	32.0				
6. N_2K_2 ..	0.6005	0.9260	54.2	0.5761	0.8496	47.5	0.5928	0.9499	60.2	54.0				
7. $N_1P_1K_1$..	0.6742	0.7568	12.3	0.5423	0.7747	42.9	0.6163	0.9255	50.2	35.1				
8. $N_2P_2K_2$..	0.6362	0.9642	43.0	0.7094	0.9024	27.2	0.6670	1.0310	65.4	45.2				
9. Control ..	0.5960	0.8228	48.1	0.6579	0.8328	26.6	0.5973	0.7008	17.3	30.7				
10. Plain Water ..	0.6868	0.7003	2.0	0.7787	0.9568	22.9	0.6548	0.8397	28.2	17.7				

Total K in Young Leaves

1. N ₁ ..	..	3.346	3.279	— 2.00	3.836	4.300	12.10	2.895	3.424	18.27	9.46
2. N ₂ ..	..	4.173	4.221	1.15	5.006	4.678	— 6.71	2.851	2.815	— 1.26	— 2.27
3. N ₁ P ₁ ..	..	3.480	3.448	— 0.92	4.312	4.333	0.49	4.091	4.106	0.37	— 0.02
4. N ₂ P ₂ ..	..	2.954	3.238	9.61	2.865	3.103	8.31	3.508	3.473	— 1.00	5.64
5. N ₁ K ₁ ..	..	3.157	3.241	2.66	2.866	3.493	21.88	4.117	3.109	— 24.47	0.02
6. N ₂ K ₂ ..	..	4.028	3.765	— 6.53	3.509	4.113	17.21	3.072	2.981	2.96	4.55
7. N ₁ P ₁ K ₁ ..	..	2.980	3.395	13.93	3.171	3.297	3.97	4.583	4.355	— 4.97	4.31
8. N ₂ P ₂ K ₂ ..	..	3.782	4.297	12.30	3.700	3.813	3.05	2.767	3.917	41.57	18.97
9. Control ..	..	2.834	3.015	9.63	4.019	4.113	2.34	4.042	4.251	5.17	5.71
10. Plain Water ..	..	5.772	5.864	1.78	3.902	3.763	— 3.56	3.119	2.937	— 5.84	— 2.57

Percentage of Total P₂O₅ in Old Leaves

1. N ₁ ..	..	0.2699	0.3796	40.49	0.6053	0.5635	— 6.90	0.4779	0.4682	— 2.03	10.52
2. N ₂ ..	..	0.3875	0.4608	18.91	0.2906	0.5388	85.43	0.2941	0.3042	3.44	35.93
3. N ₁ P ₁ ..	..	0.3403	0.4780	40.28	0.5362	0.4650	0.12	0.7893	0.5632	— 28.64	3.92
4. N ₂ P ₂ ..	..	0.4201	0.7254	72.68	0.2443	0.6769	172.1	0.2889	0.5289	83.07	110.95
5. N ₁ K ₁ ..	..	0.2444	0.3092	26.52	0.2885	0.4606	59.60	0.4009	0.2756	— 3.12	27.67
6. N ₂ K ₂ ..	..	0.3832	0.6546	70.82	0.2889	0.4317	49.42	0.3000	0.4151	38.37	52.87
7. N ₁ P ₁ K ₁ ..	..	0.2414	0.4542	88.14	0.2441	0.4668	91.24	0.1951	0.7993	304.1	162.49
8. N ₂ P ₂ K ₂ ..	..	0.3410	0.6354	83.73	0.5851	0.7023	20.03	0.7147	0.6738	— 5.72	32.68
9. Control ..	..	0.3315	0.6319	90.63	0.2478	0.4324	74.49	0.2753	0.4148	50.67	71.93
10. Plain Water ..	..	0.2540	0.7450	193.3	0.2888	0.7060	144.4	0.2945	0.2711	— 7.81	109.96

APPENDIX LI (A)

Analytical Data of Buds Developing to Blossoms Collected in April 1957

Values on Moisture-free basis

Treat- ments	2nd Day				4th Day				6th Day				8th Day			
	Orga- nic carbon %	Total Nitro- gen %	Total ash %	Total P ₂ O ₅ %	Total K ₂ O %	Orga- nic carbon %	Total Nitro- gen %	Total Ash %	Total P ₂ O ₅ %	Total K ₂ O %	Orga- nic carbon %	Total Nitro- gen %	Total Ash %	Total P ₂ O ₅ %	Total K ₂ O %	
52 Clearing Kents																
0	36.24	4.403	5.81	1.060	4.886	50.65	3.875	6.67	1.016	4.823	53.08	3.756	8.02	1.145	4.355	8.227
I	65.34	3.565	6.24	0.833	4.166	51.41	4.087	7.14	1.131	5.729	51.10	3.889	8.43	1.002	7.804	7.665
II	49.25	4.319	7.04	1.114	5.409	54.95	4.620	7.88	1.347	7.121	49.57	4.207	9.64	1.220	7.789	9.876
III	51.98	4.417	7.08	1.069	5.438	49.92	4.767	8.08	1.327	7.328	48.93	5.960	9.09	1.319	8.793	7.544
Rubber Area Selections																
0	51.51	3.410	6.69	0.315	5.583	47.44	3.804	7.44	0.613	4.119	48.99	3.274	6.34	0.938	4.969	5.065
I	59.70	3.108	6.66	0.968	5.127	49.39	3.530	5.64	0.623	3.697	52.89	2.671	7.97	1.237	5.812	5.463
II	48.39	4.145	6.67	1.570	6.077	44.07	3.959	6.31	0.745	4.833	48.41	4.004	9.51	1.119	7.878	9.05
III	51.64	2.895	7.62	0.619	4.656	50.00	3.728	8.62	1.108	6.944	44.19	3.435	8.98	1.028	8.403	9.839

Treatments: 0—No Treatment. I—Spraying water on the crown only leading the drip water away from the plant.

II—Same quantity of water on the crown and allowing the drip water to soak into the soil at the base of the plants. III—Same quantity of water applied at the base of the plants.

Note.—Full blossom in Treatments II and III on the 8th day. No change practically in Treatments.

Analytical Data of the Buds Developing to Blossoms, Collected from Different Species and Varieties of Coffee

(Samples Collected between 27-3-1958 and 2-4-1958)

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Plant material	Date of collection of buds	Moisture %	Dry matter %	Average weight of one bud in mgm.	Ash content %	Organic carbon %	Total Nitrogen (Moisture free) %	Total P ₂ O ₅ (Moisture free) %	Total K ₂ O (Moisture free) %
1. Coffee Arabica—Kents	27-3-1958	66.37	33.63	23.06	7.95	53.50	1.672	0.9477	4.444
	28-3-1958	74.74	25.26	26.10	8.52		2.827	0.9315	4.974
	29-3-1958	76.72	23.28	43.45	7.20	53.40	2.258	0.9681	5.727
	30-3-1958	78.09	21.91	44.39	6.48	57.03	3.243	0.9497	5.683
	31-3-1958	84.10	15.90	100.90	8.33	48.75	1.385	0.9187	4.370
	1-4-1958	78.38	21.62	60.99	7.78	54.64	4.324	1.3010	5.204
	2-4-1958	80.00	20.00	74.99	9.57	51.16	1.413	1.4350	6.982
2. Coffee Arabica—S. 288	27-3-1958	74.35	25.65	27.67	6.79	52.16	2.662	1.4760	8.547
	28-3-1958	80.19	19.81	36.00	9.00	52.81	2.528	1.2930	9.290
	29-3-1958	83.45	16.55	50.58	9.37	52.05	2.645	1.3280	10.190
	30-3-1958	85.45	14.55	72.95	9.85	53.11	2.522	1.2370	9.956
	31-3-1958	86.82	13.18	89.78	10.60	53.33	2.244	1.1020	9.972
	1-4-1958	84.72	15.28	92.72	8.50	51.88	1.708	1.1300	6.175
	2-4-1958	85.72	14.28	107.60	8.65	56.06	1.812	1.2230	5.232
3. Coffee Arabica—S. 333	27-3-1958	77.41	22.59	37.81	8.68	51.83	1.777	1.1810	6.455
	28-3-1958	81.72	18.28	54.86	10.10	53.30	2.688	1.1450	9.385
	29-3-1958	85.00	15.00	79.16	8.86	57.20	3.454	1.1630	5.727
	30-3-1958	86.10	13.90	95.90	10.61	56.27	1.701	1.1570	6.448
	31-3-1958	88.63	11.37	157.10	8.48	55.51	2.532	1.0070	9.160
	1-4-1958	86.84	13.16	149.60	12.83	51.89	1.979	1.1990	9.189
	2-4-1958	87.76	12.30	195.00	14.85	48.35	2.071	1.3800	8.312
4. Coffee Arabica—S. 795	27-3-1958	72.64	27.36	26.06	7.11	48.25	2.112	1.2300	8.660
	28-3-1958	78.18	21.82	38.25	8.29	49.76	2.375	1.2230	8.980
	29-3-1958	80.35	19.65	57.15	8.81	52.44	2.411	1.3700	9.375
	30-3-1958	85.35	14.65	73.18	9.23	64.21	1.144	1.3160	9.358
	31-3-1958	80.00	20.00	72.01	8.01	54.24	2.607	1.1170	10.316
	1-4-1958	81.93	18.07	91.26	7.90	50.76	3.639	1.0910	6.273
	2-4-1958	84.01	15.99	113.60	8.78	50.49	1.731	1.0640	6.890
5. Coffee—Robusta	27-3-1958	73.50	26.50	32.68		50.37	2.476	0.9614	6.936
	28-3-1958	79.58	20.42	49.79	4.66	50.39	1.692	1.0760	5.996
	29-3-1958	82.15	17.85	70.20	8.68	50.83	5.688	0.7625	7.066
	30-3-1958	82.94	17.06	63.08	10.40	51.65	6.129	0.7834	6.244
	31-3-1958	83.60	16.40	124.20	9.75	53.14	2.157	0.7674	7.640
	1-4-1958	83.03	16.97	111.50	10.21	44.89	0.806		
6. Coffee Excelsa—(Tree Coffee)	27-3-1958	73.50	26.50	49.58	6.02	45.06	2.739	0.6017	3.461
	28-3-1958	71.20	28.80	62.56	6.53	47.71	2.677	1.4330	7.498
	29-3-1958	76.43	23.57	82.68	6.72	45.19	1.986	1.0290	8.370
	30-3-1958	77.76	22.24	109.70	6.82	49.10	2.134	1.1390	8.370
	31-3-1958	80.58	19.42	155.00	4.96	49.28	1.496	1.1370	9.770

APPENDIX LII

*Comparative Trials on the Efficacy of B.H.C., Dieldrin and Chlordane
in the Control of White Stem Borer*

Location : Shegode Estate.

Started : October 1955.

Symbol	Treatments	Initial No. of plants	No. of borer infested plants	Per cent. infes- tation	Initial No. of plants	No. of borer infested plants	Per cent. infes- tation
		1956-57			1957-58		
A	Control	295	8	2.6	367	5	1.36
B	B.H.C. 50% W.P. 3 applica- tions per year (1.0%) ..	319	5	1.6	381	1	0.26
C	Dieldrin W.P. 0.25% 2 applications per year	268	3	1.1	380	3	0.78
D	Dieldrin W.P. 0.25% 3 applications per year	282	3	1.1	390	1	0.25
E	Dieldrin W.P. 0.125% 2 applications per year	315	7	2.2	387	1	0.25
F	Dieldrin W.P. 0.125% 3 applications per year	316	13	4.0	382	5	1.30
G	Dieldrex '18' emuln. 0.25%—2 applications per year	335	4	1.2	393	0	..
H	Dieldrex '18' emuln. 0.25%—3 applications per year	305	2	0.7	382	5	1.30
I	Dieldrex '18' emuln. 0.125%—2 applications per year	304	8	2.6	394	1	0.25
J	Dieldrex '18' emuln. 0.125%—3 applications per year	302	3	1.0	376	1	0.26
K	Chlordane 0.09% 3 applications per year	308	4	1.3	386	9	2.33
Mean ..				1.76			0.76

Significant or not: Not significant.

S.E. % of mean (1957): 69.66.

Replications : 4.

Plot size: 100 plants.

S.E. % of mean (1956): 33.49

Treatments: 11.

Lay-out: Randomized.

APPENDIX LIII

Efficacy of Chlordane, B.H.C. and Dieldrin on White Stem Borer Control

Locality: Coffee Research Substation, Chethalli.

Started: April, 1955.

Symbol	Treatments	April 1955—April 1956			October 1956—October 1957		
		Initial No. of plants	No. of Borer removals	Per cent. inci- dence	Initial No. of plants	No. of Borer removals	Per cent. inci- dence
A	Chlordane 0·01%— 2 applications per year	291	1	0·34	291	4	1·37
B	B.H.C. 1·0%—3 applica- tions per year ..	295	1	0·33	296	0	..
C	Control	283	3	1·06	286	1	0·34
D	Dieldrex '18' emulsion 0·25%—2 applications per year	292	1	0·34	293	1	0·34
E	Dieldrex '18' emulsion 0·125%—2 applications per year	297	1	0·33	298	0	..
F	B.H.C. 1·0%—4 applica- tions per year ..	286	3	1·04	289	1	0·34

Treatments : 6.

Lay-out: Randomized.

APPENDIX LIV

Efficacy of Heptachlor and Gusathion in Comparison with B.H.C. and Dieldrin

Location: Liaison Zones.

Started: May-November, 1956.

Zone/Estates	Control	B B.H.C. 50% W.P. (1.0%) 2 Applns. per year	C B.H.C. 50% W.P. (1.0%) 3 Applns. per year	D Dieldrin 50% W.P. (0.125%) 2 Applns. per year	E Gusa- thion (0.1%) 2 Applns. per year	F Hepta- chlor (0.1%) 2 Applns. per year	Started Data analysed up to
Borer Incidence (in per cent.)							
<i>Yercaud</i>							
1. Maryland ..	2.41	0	0.50	1.0	0	1.04	Oct. 1956 May 1958
2. Arcadia ..	0	0	0	0	0	0	"
3. Belvidere ..	0	0	0	0	0	0.96	"
<i>Coimbatore</i>							
Glenburn ..	1.82	0	0	0	0	0	May 1956 Apr. 1958
<i>Chikmagalur</i>							
Thogarhankal ..	3.9	0.7	1.1	1.1	1.8	1.1	Oct. 1956 July 1958
<i>Somwarpet</i>							
Madegode ..	0	0	0	0.83	0.83	0	May 1956 Sept. 1957
<i>Kalpetta</i>							
Rockwood ..	2.97	0.9	0	0	2.04	2.83	May 1956 May 1958
<i>Gonikoppal</i>							
Balemane ..	1.25	0	0	0	0	0	Nov. 1956 Oct. 1957
<i>Mudigere</i>							
1. Chandrapore	0	0	1.25	0	0	0	May 1956 Oct. 1957
2. Bettadamane	0	0	0	0	0	0	"
3. Baskal ..	2.50	0	1.25	1.25	0	0	"

Treatments : 6.

Replications : 4.

Lay-out : Randomized.

Note.—(1) Data on borer incidence from Cheekanahalli, Sirugur and Annemahal Estates in the Sakalaspur Zone have been inconclusive—hence not included.

(2) Data of Experiment at Ponnathumotte (S. Coorg) are not complete—hence not included.

APPENDIX LV

Trials with Soil Amendments, With and Without Sulphur on the Control of
Coffee Eelworms

Location: Yemmegundi Estate.

Started: November, 1956.

Months	Treatments	Depth counts average				Total
		0-9"	9-18"	18-27"	27-36"	
November, 1956	A	6.6	1.6	1.4	0.4	10.0
	B	6.0	3.4	1.8	0.8	12.0
	C	5.2	3.2	0.4	0.2	9.0
	D	7.8	1.4	0.2	0.4	9.8
	TOTAL ..	25.6	9.6	3.8	1.8	40.8
December, 1956	A	3.4	3.8	4.4	6.2	17.8
	B	1.4	1.6	0.6	0.8	4.4
	C	1.0	0.6	2.2	2.2	6.0
	D	2.4	2.6	1.6	0.6	7.2
	TOTAL ..	8.2	8.6	8.8	9.8	35.4
April, 1957 ..	A	4.6	5.2	5.2	6.4	21.4
	B	2.8	1.6	1.8	2.0	8.2
	C	1.8	2.2	1.8	2.0	7.8
	D	3.4	2.4	3.2	2.4	11.4
	TOTAL ..	12.6	11.4	12.0	12.8	48.8
June, 1957 ..	A	2.8	3.4	3.2	1.6	11.0
	B	2.4	1.0	0.8	0.2	4.4
	C	1.8	1.4	1.4	0.6	5.2
	D	2.4	2.4	1.4	1.0	7.2
	TOTAL ..	9.4	8.2	6.8	3.4	27.8
September, 1957	A	2.0	1.6	1.6	0.8	6.0
	B	2.0	0.8	0.4	0.2	3.4
	C	1.2	1.0	1.0	0.4	3.6
	D	2.0	1.6	0.8	0.2	4.6
	TOTAL ..	7.2	5.0	3.8	1.6	17.6
November, 1957	A	19.2	11.2	22.8	13.2	66.4
	B	33.6	48.4	7.8	3.4	93.2
	C	13.4	19.2	4.2	4.4	41.2
	D	16.6	13.6	13.6	12.0	55.8
	TOTAL ..	82.8	92.4	48.4	33.0	256.6
March, 1958	A	0	1.4	0.4	0.4	2.2
	B	0.4	14.8	0.6	1.2	17.0
	C	0.2	1.0	0	0.6	1.8
	D	0.4	1.4	0.2	0.6	2.6
	TOTAL ..	1.0	18.6	1.2	2.8	23.6
GRAND TOTAL ..		146.8	153.8	84.8	65.2	450.6

Treatments: 4. (A) Control (normal dose of manure 60:30:40 twice applied).
 (B) Soil amendments (Cal. cyanamide, wet sulphur + Urea + P and K 30:40).
 (C) Wet Sulphur + Manure 60:30:40-NPK
 (D) Sulphur + Manure 60:30:40-NPK

Replications: 5. Lay-out: Randomized. Plot size: 9 plants.

APPENDIX LVI

*Trials with V.C. 13, Nemacide on the Control of Coffee Eelworms**Location:* Coovercolly Estate.*Started:* November 1956.

Months	Treatments	Depth counts average				Total
		0-9"	9-18"	18-27"	27-36"	
November, 1956	A	4.9	4.5	4.5	1.9	15.8
	B	7.3	4.2	6.7	2.9	21.1
	TOTAL ..	12.2	8.7	11.2	4.8	36.9
January, 1957 ..	A	0.9	1.3	2.1	2.1	6.4
	B	4.5	3.3	3.3	3.0	14.1
	TOTAL ..	5.4	4.6	5.4	5.1	20.5
May, 1957 ..	A	1.6	2.1	2.2	1.7	7.6
	B	5.2	4.6	4.9	3.6	18.3
	TOTAL ..	6.8	6.7	7.1	5.3	25.9
March, 1958 ..	A	0.2	0.7	0	0	0.9
	B	0	0	0	0.4	0.4
	TOTAL ..	0.2	0.7	0	0.4	1.3
GRAND TOTAL		24.6	20.7	23.7	15.6	84.6

Treatments: 2. (A) V.C. 13. Nemacide. 1 lb. in 50 gallons of water; 1 gallon/plant applied to an area of 2 sq. ft. of soil around the plant.

(B) Control.

Replications: 10.

Lay-out: Randomized.

Plot-size: 4 plants.

APPENDIX LVII

Spray Experiment to find out the Efficacy of Adding Detergents, Wetters, Spreaders and Adhesives to Bordeaux Mixture

Locality: "Q" Block, Coffee Research Station, Balehonnur. Replication: 4. Lay-out: Randomized. Treatment: 8.

Started: May 1954. Plot Size: Gross—6 rows of 13 plants = 78; Net—4 rows of 11 plants = 44.

Treatments	Effective percentage of leaf survival						Yield of ripe cherry in lb./acre			
	Sept. 1954	Feb. 1955	Sept. 1955	Feb. 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958	Sept. 1958	Feb. 1959
A. Bordeaux Mixture 0.5%	..	..	49.01	50.80	67.23	47.55	42.30	42.90	49.45	31.50
B do. +1½ oz. Teepol in 40 gal. water	53.94	48.95	65.30	43.15	42.80	37.85	40.80	35.75	7142	2305
C do. +6 oz. Stanvac detergent	54.13	53.80	68.20	47.55	46.50	44.95	46.11	38.00	6731	1894
D do. +7½ oz. Corvus oil	41.82	57.20	65.40	44.05	46.90	39.50	39.79	33.00	4404	2053
E do. +10 oz. Arkotone	51.54	57.50	This treatment discontinued for want of chemical.				6887	This treatment discontinued.		
F do. +1½ oz. Lissapol	51.68	54.70	67.30	49.75	43.40	45.75	52.37	38.75	5901	1644
G do. +1 oz. Agral	39.96	47.75	59.56	48.45	41.30	54.06	52.83	36.25	6236	1839
do. +1 oz. Adhesive YF. 3198	38.78	45.10	66.90	48.20	41.20	46.05	50.30	33.00	Only one replication is being treated for want of material and hence no yield record.	
General Mean	47.60	51.98	65.79	46.90	43.51	44.52	47.38	33.00	2070	8046
S.E.M.	3.66	3.14	3.31	3.02	1.80	2.43	3.12	3.13	466	1416
Significance	Yes	Yes	No	No	No	Yes†	Yes*	No	No	No
Critical difference (5%)	10.59	9.09	9.67	..	..	7.08	9.11	..	..	..
Conclusions	CBFEADGH	EDFCABGH	..	..	GHFCADB	GFHACBD	..	..	..	..

APPENDIX LVIII

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with that of Bordeaux Mixture

Locality: 'O' and 'M' Block, Coffee Research Station, Balehonnur. *Replication:* 4. *Lay-out:* Randomized. *Treatment:* 4.
Started: May 1953. *Plot size:* Gross—6 rows of 20 plants=120. Net—4 rows of 18 plants
 = 72.

Treatments	Effective percentage of leaf survival								Yield of ripe cherry in lb./acre					
	Feb. 1954	Sept. 1954	Feb. 1955	Sept. 1955	Feb. 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958	1953- 54	1954- 55	1955- 56	1956- 57	1957- 58
A Wetcol—15	..	55.36	44.18	53.01	55.85	46.20	40.60	39.51	50.24	33.50	4102	3723	1638	3272 3877
B Fungi-Copper Geigy ..	..	52.85	39.05	48.20	53.24	51.90	46.20	50.90	55.74	39.25	3636	1780	2184	2924 4254
C Cupravit	..	50.31	51.55	43.50	51.61	48.35	42.40	48.95	43.43	36.25	3202	3855	1609	2497 3357
D Bordeaux 1%	..	51.32	44.91	52.25	59.46	49.70	49.10	47.60	54.43	42.75	4203	3081	1675	3881 4917
General Mean	..	52.46	44.92	49.26	55.04	49.04	44.61	46.75	50.96	37.93	..	3104	1777	3143 4101
S.E.M.	..	1.46	3.42	2.92	2.72	1.63	1.73	2.69	2.53	1.54	..	738.9	307	536 293.5
Significance	..	Yes	Yes	Yes	No	No	Yes*	No.	No	No	..	No	No	No Yes*
Critical difference (5%)	..	4.51	10.54	8.98	..	..	5.34	..	..	..	..	..	..	938.7
Conclusions	..	<u>ABDC</u>	<u>CDAB</u>	<u>ADBC</u>	..	..	<u>DBCA</u>	..	..	..	..	..	..	<u>DBAC</u>

APPENDIX LIX

*Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture**Locality:* Shegade Estate, Balehonnur.*Replication:* 4. *Lay-out:* Randomized. *Treatment:* 6.*Started:* September 1954.*Plot size:* Gross—6 rows of 20 plants = 120. Net—4 rows of 18 plants = 72.

Treatments	Effective percentage of leaf survival							Yield of ripe cherry in lb./acre					
	Sept. 1954 (Initial)	Feb. 1955	Sept. 1955	Feb. 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958	1954- 55	1955- 56	1956- 57	1957- 58	
A Bordeaux 0.5%	..	67.95	55.45	74.03	35.90	65.10	48.10	49.22	41.75	2270	2517	2453	2957
B Perenox ..	..	74.20	39.45	60.57	26.35	53.70	36.90	38.96	40.65	2287	2011	2484	2264
C Blitox ..	..	70.00	45.20	71.03	43.15	67.60	47.60	41.92	46.50	1614	1762	1752	2290
D Shell Copper fungicide	81.33	45.90	79.02	33.60	68.70	45.60	37.07	38.25	1387	1846	2405	1857	
E Parry's Bye-product ..	76.45	51.40	This treatment discontinued for want of material.						2069	This treatment discontinued.			
F Dithane Z. 78 ..	..	77.13	45.40	71.33	28.35	66.70	38.95	42.75	43.50	1850	1033	1760	1455
General Mean ..	..	47.13	71.19	33.47	64.31	43.43	41.98	42.13	..	1834	2171	2165	
S.E.M. ..	..	4.94	2.89	5.99	2.71	2.86	2.63	4.06	..	282	202	253	
Significance ..	..	Yes	Yes	No	Yes†	Yes*	Yes*	No	..	Yes*	Yes*	Yes*	
Critical difference (5%)		14.56	8.65	..	8.13	8.58	7.88	..	..	870	622	780	
Conclusions ..		<u>AEDFCB</u>	<u>DAFCB</u>	..	<u>DCFAB</u>	<u>ACDFB</u>	<u>AFCRD</u>	..	..	<u>ABDCF</u>	<u>BADFC</u>	<u>ACBDF</u>	

APPENDIX LX

*Spray Experiment to Compare the Efficacy of Blitox Ipsilon with Bordeaux Mixture**Locality:* Crawford area—Coffee Research Station, Balehonnur.*Replications:* 5.*Lay-out:* Randomized.*Treatments:* 9.*Plot size:* Gross—3 rows of 3 plants = 9.*Net:* Middle plant in middle row.*Started:* June 1956.

Treatments		Effective percentage of leaf survival		
		Feb. 1957	Sept. 1957	Feb. 1958
A	Blitox Ipsilon at 5 lb. in 300 gal. per acre	40.00	49.44	32.00
B	„ „ at 10 lb. do.	40.15	40.56	37.25
C	„ „ at 15 lb. do.	44.20	52.55	33.75
D	„ „ 5 lb. in 400 gal. per acre ..	36.85	44.62	33.50
E	„ „ at 10 lb. do. ..	40.50	43.34	30.75
F	„ „ at 15 lb. do. ..	41.70	46.22	31.00
G	Bordeaux $\frac{1}{2}\%$ at 400 gal. per acre	46.70	56.77	32.75
H	Control	34.00	40.13	31.50
I	Bordeaux $\frac{1}{2}\%$ at 300 gal. per acre	49.20	48.04	33.75
	General Mean	41.48	46.85	32.92
	S.E.M.	5.03	2.78	3.10
	Significance	No.	Yes†	No.
	Critical difference (at 5% level)	..	7.70	..
	Conclusions	G C A I F D E B H		

APPENDIX LXI

*Spray Experiment to Compare Mercurised Copper Oxchloride with Bordeaux Mixture**Locality:* L₁ Block, Coffee Research Station, Balehonnur.*Replications:* 4. *Lay-out:* Randomized. *Treatments:* 6.*Started:* September 1954.*Plot size:* Gross—5 rows of 5 plants = 25. Net—Middle 5 plants.

Treatments		Effective percentage of leaf survival									
		September 1954 (Initial)	February 1955	September 1955	February 1956	September 1956	February 1957	September 1957	February 1958		
A.	Bordeaux 0.5%	..	..	58.33	41.30	51.46	49.95	47.40	46.40	48.81	39.50
B.	Mercuric Copper Oxy./Chloride	0.2%	..	75.64	64.40	66.59	49.50	39.90	41.60	37.98	33.50
C.	do.	do.	0.3%	65.67	56.70	47.66	45.45	42.80	41.95	39.33	40.00
D.	do.	do.	0.4%	74.48	48.35	57.96	40.95	40.20	36.25	36.61	35.75
E.	do.	do.	0.5%	69.74	59.85	57.57	42.70	45.50	26.25	31.38	34.50
F.	Copper Sandoz	..	..	60.06	46.70	51.58	49.45	44.70	44.85	45.53	36.75
	General Mean	..	..	..	52.88	56.61	46.33	43.45	39.62	39.94	36.67
	S.E.M.	..	..	..	6.47	4.83	5.21	4.10	4.91	2.07	2.60
	Significance	..	..	..	Yes	No	No	No	Yes†	Yes†	No
	Critical difference (5%)	..	..	..	19.09	..	..	..	10.24	6.11	..
	Conclusions	..	..	..	<u>BECDF A</u>	..	..	..	<u>AFCBDE</u>	<u>AFCBDE</u>	..

APPENDIX LXII

*Spray Experiment to Compare the Efficacy of Proprietary Fungicides with
Bordeaux Mixture*

Locality: 'L₁' Block, Coffee Research Station, Balehonnur.

Replications: 5.

Lay-out: Randomized.

Treatments: 10.

Started: June 1956.

Plot size: Gross: 3 rows of 3 plants = 9.

Net: Middle plant in middle row.

Treatments	Effective percentage of leaf survival		
	Feb. 1957	Sept. 1957	Feb. 1958
A. Cuprokylt 1 lb. in 40 gal.	42.05	44.55	38.25
B. M.C.M. Copper oxychloride 1 lb. in 40 gal.	47.75	41.38	37.00
C. Colloidal copper (Bharats) 1 lb. in 40 gal. . .	48.30	42.25	39.50
D. Flit-406 0.2% + Ortho Sticker	49.60	45.01	44.25
E. " 0.4% + "	51.20	38.04	45.25
F. Ultra Sulphur 1 lb. in 60 gal.	37.85	36.25	29.00
G. Bordeaux Mixture ½%	45.55	47.13	37.50
H. " " + Tenac sticker	49.75	49.27	39.00
I. " " + Ortho sticker	56.25	49.50	43.50
J. Control No Spray	35.75	29.63	28.50
General Mean	46.40	42.30	38.18
S.E.M.	3.73	3.02	2.72
Significance	Yes†	Yes†	Yes†
Critical difference (at 5% level)	7.31	8.37	7.54
Conclusions	.. IEHDCBGAFJ IHGDACBEFJ EDICHAGBEFJ		

APPENDIX LXIII

*Spray Experiment to Compare the Efficacy of Proprietary Fungicides with
Bordeaux Mixture*

Locality: 'Q' Block, Coffee Research Station, Balehonnur.

Replications: 5.

Treatment: 5. Started: May, 1957.

Plot size: Gross: 6 rows of 5
plants = 30.

Net: Middle 5
plants.

Treatments	Effective percentage of leaf survival		Mean percentage of diseased leaves		
	Sept. 1957	Feb. 1958	July 1957	Sept. 1957	July 1958
A. Cobredon 17.6 oz. in 40 gal.	36.31	31.25	62.79	88.99	85.42
B. Cupricol 1 lb. in 40 gal.	29.08	31.00	85.00	89.73	84.89
C. Dithane M-22 0.4% (4 applications a year)	44.31	42.75	51.54	81.33	69.85
D. Bordeaux ½%	46.83	35.25	44.15	85.24	81.66
E. Control	27.43	26.25	87.62	87.26	93.37
General Mean	36.79	33.30			
S.E.M.	3.09	2.45			
Significance	Yes†	Yes†			
Critical difference (at 5% level)	9.26	7.35			
Conclusions	..DCABE		C D A B E		

APPENDIX XLIV

*Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture**Locality:* Coffee Research Substation, Chethalli.*Started:* in May 1953—Post-monsoon.*Replications:* 5. *Lay-out:* Randomized. *Treatments:* 5.*Plot size:* Gross—1 row of 15 plants with common guard rows between treatments. Net—13 plants.

Treatments	Effective percentage of leaf survival					Yield of ripe cherry in lb./acre							
	Sept. 1954	Feb. 1955	Sept. 1955	Feb. 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958	1954- 55	1955- 56	1956- 57	1957- 58	
A. Wetcol -15	..	13.3	44.85	80.61	43.3	82.71	40.40	78.62	40.88	3264	2164	7203	3404
B. Bordeaux 0.5%	..	14.9	51.93	86.83	53.4	77.50	49.50	85.72	34.88	4112	2346	8553	5177
C. Control ..	..	11.9	49.30	73.80	41.2	72.63	56.60	71.77	37.70	3312	2788	5845	2999
D. Cupravit	..	12.9	48.44	77.96	39.3	83.28	38.40	72.48	33.70	3024	1856	8122	2922
E. Yellow Cuprocide	14.6	47.93	86.65	55.1	75.61	40.96	81.57	38.22	3504	2055	6796	2635	
General Mean	..	48.49	81.17	46.46	78.14	44.97	78.03	37.03	3440	2242	7304	3427	

APPENDIX LXV

*Spray Experiment to Compare the Efficacy of Proprietary Fungicides
with Bordeaux*

Locality: Coffee Research Substation, Chethalli.

Lay-out: Randomized.

Replications: 4.

Started: May, 1957.

Treatments: 9.

Plot size: Gross: 3 rows of
5 plants = 15.

Net: Middle 3 plants
in middle row.

Treatments	Effective percentage of leaf survival		Mean percentage of disease incidence	
	Sept. 1957	Feb. 1958	July 1957	July 1958
A. Flit406 0.2% (2 sprays a year)	84.18	34.70	60.63	38.4
B. „ 0.4% do.	82.62	35.75	63.30	33.0
C. „ 0.6% do.	80.20	35.50	67.15	48.6
D. „ 0.4% + Tenac sticker (2 sprays a year) ..	78.62	37.56	73.20	35.3
E. Bordeaux mixture 0.5% (2 sprays a year) ..	86.72	42.25	52.77	26.1
F. „ „ 0.5% + Tenac sticker (4 sprays a year)	84.54	40.25	53.12	31.4
G. Kirti-copper 1 lb. in 40 gal. (2 sprays a year) ..	69.65	33.90	63.72	24.6
H. Control	68.75	29.40	70.12	59.6
I. Flit-406—0.4% + Tenac sticker (4 sprays a year)	82.40	40.38	65.07	38.4
General Mean	79.74	36.62	..	..
S.E.M.	0.73	3.81	..	..
Significance	Yes†	No.	..	..
Critical difference	2.13	..	..	..
Conclusions	E F A B I C D G H			

APPENDIX A

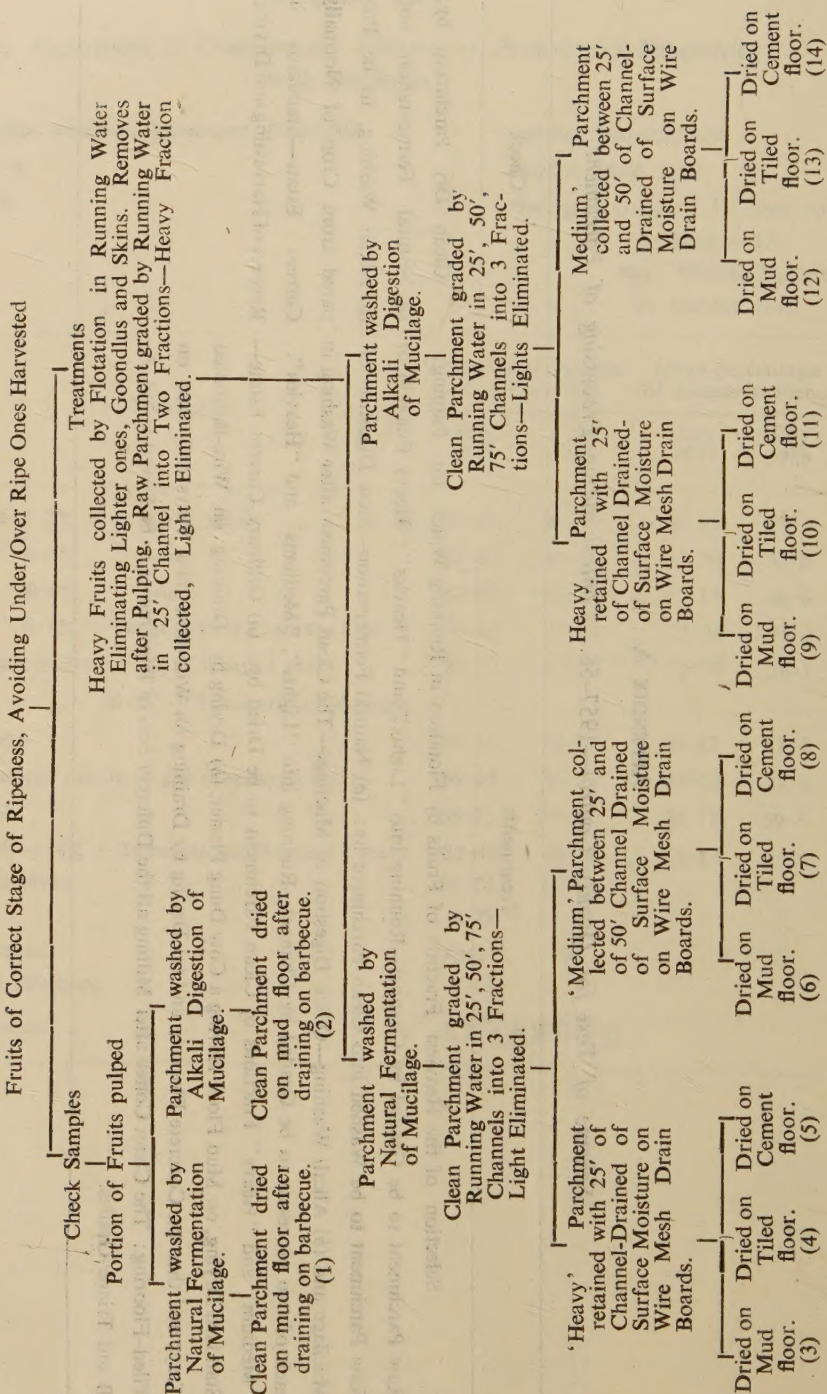
Scheme of Test for Quality Control—1957-58. Control during Processing of Parchment

Treatments	Check
Selection of the Heaviest Fraction of Fruits by Flotation in Running Water for Pulping: Raw Parchment to be Graded by Channel—Running into "Lights" and "Heavies": Heavy Fraction of (a) Natural Fermentation and Raw Parchment to be Washed into Clean Parchment by: (a) Natural Fermentation—Slow Digestion of (b) Alkali Washing, to be Pre-Mucilage and (b) Alkali Washing—Quick Digestion of Mucilage—The Clean Parchment after Washing in pared from Crop of Normally each of two processes to be Graded by Channel—Running into "Lights", "Mediums" and "Heavies". Current Estate—Standards in "Medium" and "Heavy" Fractions of Clean Parchment to be Dried by: (a) Ordinary Current Estate— Respect of Harvesting and Drying. Standard Drying, on Mud Floor Having a Cow Dung Plaster, (b) Drying by Draining on Wire-Bottomed Trays and then on Concrete Flooring and (c) Drying by Draining on Wire-Bottomed Trays and then on Tiled-Flooring: The Clean Coffee after Milling all the Different Sets of Parchments to be Sieved to get A, B and Triage Grades.	

APPENDIX B

Quality Control Tests 1957-58

Flow Chart of Processing of Parchment



All 14 Samples after drying in the open to constant weight hulled and graded into A, B and Triage.

Four Types of Coffee—S. 795, S. 288, Kents and Bulk—From Coffee Research Station, Balehonnur, and Coffee Research Substation Chethalli.

